



November 24, 2010



Mr. Ed Stuart
Department of Environmental Quality
Northern Regional Office
13901 Crown Court
Woodbridge, VA 22193

Subject: Rappahannock Water and Sewer Authority Town of Sperryville WWTP
Copper Limit Compliance Strategy Water Effects Ratio Study

Dear Mr. Stuart,

Please see the enclosed copy of the Water Effects Ratio (WER) Study conducted at the Sperryville WWTP in 2010 as part of the planned copper compliance strategy for the Rappahannock Water and Sewer Authority (RWSA). Enclosed are two (2) copies of the completed WER Study. Additionally, ESS will submit a separate copy to be sent to Mr. Alex Barron at DEQ Central Office and send the last copy to RWSA.

Should you have questions or comments, please feel free to contact me at 540-825-6660.

Best regards,


Cody J. Hoehna, Operations Manager
Environmental Services Division

Cc: Mr. Alex Barron, DEQ
Mr. Kenneth Thompson, RWSA

Thompson, Alison (DEQ)

From: Thompson, Alison (DEQ)
Sent: Wednesday, December 08, 2010 1:11 PM
To: Barron, Alex (DEQ)
Cc: Thompson, Alison (DEQ)
Subject: Town of Sperryville WER Study for Copper
Alex,

The Town of Sperryville has submitted the completed WER Study for Copper. I will place a copy of the report in the mail for you. We met with their consultant (Don Hearl from ESS) a year or so ago to discuss the possibility.

Once you receive the report, please let me know if there is anything else you need from Northern.

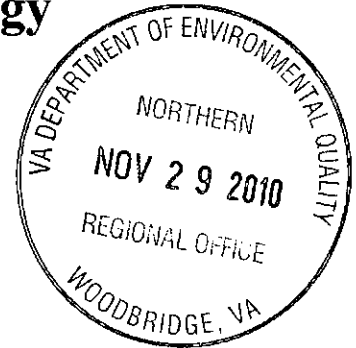
alison

Alison Thompson
Water Permits Technical Reviewer
Virginia Dept of Environmental Quality
Northern Regional Office
13901 Crown Ct
Woodbridge, VA 22193
(703) 583-3834
alison.thompson@deq.virginia.gov

To Alex 12/8/10 via
intraoffice mail

12/8/2010

Rappahannock Water and Sewer Authority
Town of Sperryville WWTP
Copper Limit Compliance Strategy
Water Effects Ratio Study



Prepared for,
Virginia Department of Environmental Quality

Prepared by,
Environmental System Services, LTD.

November 23, 2010

Thompson, Alison (DEQ)

From: Thompson, Alison (DEQ)
Sent: Wednesday, December 08, 2010 2:07 PM
To: Barron, Alex (DEQ)
Cc: Thompson, Alison (DEQ)
Subject: RE: Town of Sperryville WER Study for Copper

The permit expires on August 30, 2011. Ideally it would be nice to have the WER reviewed and accepted so that it could be public noticed with the permit for the reissuance.

Thanks

a

Alison Thompson
Water Permits Technical Reviewer
Virginia Dept of Environmental Quality
Northern Regional Office
13901 Crown Ct
Woodbridge, VA 22193
(703) 583-3834
alison.thompson@deq.virginia.gov

From: Barron, Alex (DEQ)
Sent: Wednesday, December 08, 2010 1:47 PM
To: Thompson, Alison (DEQ)
Subject: RE: Town of Sperryville WER Study for Copper

Hi Alison:

I found a copy of this ESS report in my mailbox Monday, so you keep your copy.

I will try to review the report as soon as I can but I probably won't be able to review the report until the first of the year. I know that our EPA reviewer will not be able to "review my review" for some time either because of prior commitments.

What do I need to know about timing issues for the Sperryville Permit? Let me know when you need a decision on the approvability of this study, and I'll do my best to get to this on time.

Thanks

From: Thompson, Alison (DEQ)
Sent: Wednesday, December 08, 2010 1:11 PM
To: Barron, Alex (DEQ)
Cc: Thompson, Alison (DEQ)
Subject: Town of Sperryville WER Study for Copper

Alex,

The Town of Sperryville has submitted the completed WER Study for Copper. I will place a copy of the report in the mail for you. We met with their consultant (Don Hearl from ESS) a year or so ago to discuss the possibility.

Once you receive the report, please let me know if there is anything else you need from Northern.

alison

12/8/2010

Alison Thompson
Water Permits Technical Reviewer
Virginia Dept of Environmental Quality
Northern Regional Office
13901 Crown Ct
Woodbridge, VA 22193
(703) 583-3834
alison.thompson@deq.virginia.gov

Town of Sperryville WWTP Copper Limit Compliance Strategy: Water Effects Ratio Study

Table of Contents

INTRODUCTION.....	2
--------------------------	----------

I. Copper Water Effect Ratio (WER) Study Protocol

A. Critical Effluent and Receiving Water Flows.....	6
B. Collection and Handling of Effluent.....	6
C. Laboratory Dilution Water.....	6
D. Conducting Toxicity Tests.....	7
E. Chemical and Other Measurements.....	7
1. Copper.....	7
2. Additional Analyses.....	9
F. Calculation of the Water Effects Ratio and Site-Specific Criteria.....	12
G. Reporting.....	12
H. Interpretation of WER Results.....	13

TABLES & FIGURES

TopoQuad of The Town of Sperryville WWTP.....	4
Table 1, Timeline of WER Testing.....	8
Table 2, WER Study Analysis.....	10
Table 3, Analytical Methods and Detection Levels for WER Study.....	11
Table 4, Summarized WER Study Events 1 and 2.....	13

APPENDICES

Appendix 1:	Flow Diagram of Town of Sperryville WWTP
Appendix 2:	Environmental Systems Service, Ltd. (ESS) Sampling Protocol for WER Study.
Appendix 3:	Coastal Bioanalysts, Inc. SOP ETS105G (Ceriodaphnia dubia Acute Test) and modifications for this project.
Appendix 4:	Coastal Bioanalysts, Inc. Report of Copper WER
Appendix 5:	Reed & Associates TOC, DOC, and Cu Analysis Report of WER Samples
Appendix 6:	ESS Analysis Report of Samples

Town of Sperryville WWTP Copper Limit Compliance Strategy: Water Effects Ratio Study Executive Summary

INTRODUCTION

The Sperryville WWTP is located in Rappahannock County in the Town of Sperryville, see *TopoQuad on Page 4*. The site is bounded by the Thornton River to the North, and undeveloped land to the south, east and west. The plant began operation in the 1970's. At that time Rappahannock Water and Sewer Authority (RWSA) was established to provide operations and maintenance (O&M) of the treatment plant. O&M services for the facility are currently provided by RWSA.

The design flow of the system is 0.055 MGD. The system consists of flow equalization, dual aeration tanks, clarifiers, a cascade aerator, and ultra-violet disinfection units. In 2007 a flow equalization tank was installed to mitigate surge flows caused by excessive Inflow and Infiltration (I&I). The ultra-violet disinfection system was installed in 2008. A schematic of the treatment flow pattern is shown in *Appendix 1*. Effluent discharged from the treatment facility enters the Thornton River via outfall 001 and is monitored to maintain compliance with VPDES Permit VA0062880.

The Thornton River (receiving stream) is located within Section 4 of the Rappahannock River Basin. In 2000 flow characteristics were reviewed and it was determined that flow in the Thornton River should be approximated using the gauging station on the Rush River at Washington, Virginia (#01662500) for the following reasons: there was no current historical stream flow data available for the Thornton River, the drainage areas are comparable, the topography at Sperryville, and both rivers are located in Rappahannock County. The water segment receiving the discharge via Outfall 001 is considered to have 7Q10 and 1Q10 of 0.0 MGD. As such, no mixing zone was allowed for this study thus 100% final effluent was used.

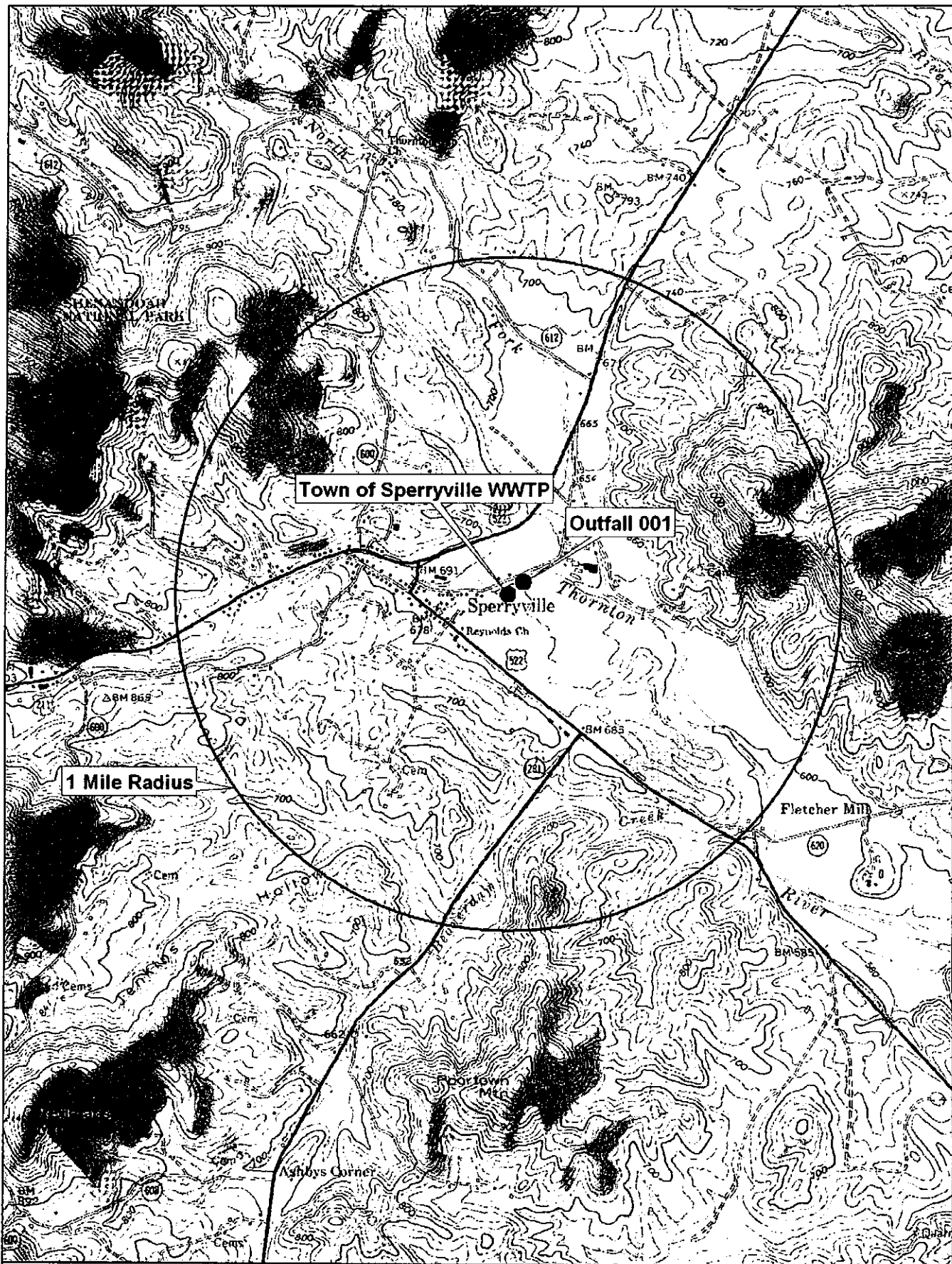
Total recoverable copper (TR Cu) and zinc limits were established for Sperryville STP in the 2004 permit reissuance. After several years of metals testing using conventional "non clean" technique RWSA submitted additional data, derived using "clean technique" for ultra-low metal detection, to the DEQ for review. A request for permit modification to revise metals concentration limits was submitted. The new data was evaluated by the DEQ and it was determined that the limit for zinc would be removed from the permit. The DEQ also decided to replace the previous limit of 6 ug/L (or parts per billion) for TR Cu with a revised limit of 18 ug/L.

Currently the treatment facility is unable to consistently achieve compliance with permitted water quality standards for copper. After significant copper monitoring, and review along with correspondence with the Department of Environmental Quality (DEQ), it has been determined that the treatment facility does not possess the technology to effectively remove metals; therefore it is very unlikely that consistent compliance can be attained, regardless of any interim treatment measures implemented. RWSA has developed, and is implementing, a compliance strategy which consists of the identification and implementation of site-specific regulatory alternatives for the permitted limit of copper.

A water effects ratio (WER) is the site-specific regulatory alternative that RWSA wishes to pursue as part of the planned compliance strategy. Initially, permit limits were established using laboratory generated criteria, which in some cases may not accurately reflect the actual impact of copper toxicity on the receiving stream. Site-specific information will be generated and used to develop a site specific copper limit based on approval from the regulatory agencies. This document contains the plans and results from conducting the proposed WER study.

RWSA utilized the services of Environmental Systems Service, Ltd. (ESS) for the collection and analysis of effluent samples and final report generation. The Standard Operating Procedures (SOPs) to be used in performing each project task have been provided to RWSA and are included as attachments to this document. Please note that these SOPs are proprietary documents and should be treated as such under the Freedom of Information Act.

The WER Study was conducted on 7/5/10 and 8/2/10. Sample results from each four hour composite sampling event and their respective WER ratio calculations have been further summarized in Section I.H on page 13. Appendices 4 through 6 include laboratory support data gathered during each of the collection events.



DELORME

© 2002 DeLorme, 3-D TopoQuads ©. Data copyright of content owner.
www.delorme.com

Scale 1 : 25,000
1" = 2080 ft



I.
Rappahannock Water and Sewer Authority
Town of Sperryville WWTP
Copper Water Effect Ratio (WER) Study Protocol

Rappahannock Water and Sewer Authority Town of Sperryville WWTP Copper Water Effect Ratio Study Protocol

This document provides the protocols that will be used by RWSA to develop a Water Effect Ratio (WER) for copper for use in permitting the discharge from Outfall 001 at Sperryville Wastewater Treatment Plant. In general, the measures used to develop the WER will follow the procedures described in EPA's guidance document *Streamlined Water-Effect Ratio Procedure for Discharges of Copper* (EPA-822-R-01-005 March 2001). Specific protocols to be used in development of the WER are presented below:

A. Critical Effluent and Receiving Water Flows

In developing the effluent limit for copper on Outfall 001, DEQ staff used an effluent flow of 0.055 MGD and the 7Q10 flow for the Thornton River of 0.0 MGD. The copper limit is based on Virginia's acute water quality criterion for the protection of aquatic life. Consequently, use of the 1Q10 flow for the Thornton River is appropriate as provided in Virginia's Water Quality Standards regulation (9 VAC 25-260-140).

B. Collection and Handling of Upstream Water and Effluent

Samples for development of the WER will be collected from Outfall 001 two sampling events spaced at least four weeks apart. It is anticipated that sampling will begin early in 2010. Normally WER studies should be conducted during a period of dry weather flow, however in this case there will be no samples from the Thornton River blended to make the ratio, due to the 7Q10 and 1Q10 flows established by the DEQ as zero.

Samples of the effluent will be collected by RWSA's contractor ESS using procedures described in *Appendix 2*. Once collected the samples will be stored at 0 – 4°C in the dark with no air space in the sample container and transported to our contract laboratory Coastal Bioanalysts, Inc. (CBI) in Gloucester, Virginia for toxicity testing. Appropriate chain of custody sample handling procedures will be used for all samples.

C. Laboratory Dilution Water

Laboratory dilution water will be synthetic freshwater prepared in accordance with *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, October 2002* (EPA-821-R-02-012). The laboratory dilution water will have DOC, TOC, and TSS concentrations < 5 mg/L, and a hardness that is reasonably close to

that of the Outfall 001 Effluent samples. The alkalinity and pH of the laboratory water will be appropriate for its hardness as given in EPA-821-R-02-012.

D. Conducting Toxicity Tests

Toxicity tests used for determination of the WER will be 48-hour, static, acute tests with *Ceriodaphnia dubia* carried out in accordance with CBI's SOP ETS105G as modified for this project, see **Appendix 3**. CBI's testing protocols are consistent with procedures described in EPA-821-R-02-012 and ASTM E 729-96.

For calculation of the final WER, RWSA plans to perform two (2) definitive WER tests using samples collected from Outfall 001 as described in Section B above. In both tests, 100% Effluent will be used, which will from this point on be referred to as "*Site Water*". The toxicity of copper spiked *Site Water* will then be compared with the toxicity of copper spiked laboratory water for determination of the WER. Preparation of the *Site Water* test solutions will generally follow the procedure described in E.15.b of Appendix A of EPA-822-R-01-005. Preparation of the laboratory water test solutions will generally follow the procedure described in E.16.b of Appendix A of EPA-822-R-01-005.

Prior to the start of each definitive test, CBI will perform 48-hour range finding tests with *Site Water* and *Laboratory Water*. The results of these tests will be used to establish the appropriate range of copper concentrations for use in the definitive WER tests.

Detailed procedures for preparation of the *Site Water* and *Laboratory Water* treatments and for the conduct of the range finding and preliminary and definitive WER tests are described in CBI's Modifications to SOP ETS105, see **Appendix 3**. A general timeline for conducting each definitive WER test is provided in Table 1 on Page 8.

E. Chemical and Other Measurements

Development of the WER will involve numerous analytical measurements for copper and other parameters performed on the *Site Water*, *Laboratory Water*, and toxicity test solutions. A narrative discussion of the planned analytical testing is provided below.

1. Copper

The number and types of planned analyses for copper are shown in Table 2 on page 10. During each of the two WER sampling events, effluent samples will be collected by ESS using "clean" sampling procedures as described in **Appendix 2**. Aliquots of both samples will be analyzed for total and dissolved copper by the contracted lab using EPA Method 200.8.

The remainder of the samples to be analyzed for total recoverable and dissolved copper, using conventional analytical methods, will be prepared by CBI in the laboratory prior to and following each WER toxicity test.

Table 1. Estimated Timeline for Conducting Each WER Test

DAY	TIME	RESPONSIBLE	ACTIVITY
0	0900	ESS	Collect Samples: Effluent, offsite no later than 1100
	1500	ESS	Deliver to CBI
	1500-1600	CBI	<ul style="list-style-type: none"> Initial water quality measurements Prepare unspiked SITE and LAB water and place in sample containers for TOC, TSS Refrigerate remaining effluent samples
	1600-1700	CBI	Set up and begin range finding tests with SITE & LAB WATER
1	1600-1700	CBI	24-hour animal counts and water quality readings range finding tests
2	1600-1700	CBI	End range finding tests <ul style="list-style-type: none"> Determine lowest concentrations causing 100% mortality (C_{RTL})
3	0800 – 0900	CBI	Begin warming Effluent
	0900-1000	CBI	Initiate preparation of SITE WATER serial dilutions: <ul style="list-style-type: none"> Prepare spiked Effluent serial dilutions Let stand 3 hours
	1230-1300	CBI	
	1300-1330	CBI	Prepare LAB WATER Treatments: <ul style="list-style-type: none"> Allow to stand 1 – 3 hours
	1430-1530	CBI	Final pretest activities: <ul style="list-style-type: none"> 30 mls each treatment removed for initial water chemistry 25 mls added to 6 test chambers * (7 Concentrations + Control) * 2 (LAB & SITE WATER) 25 mls added to 2 duplicate test chambers * (7 concentrations + Control) * 2 (LAB & SITE WATER) 150 ml each treatment (7 concentrations + Control) * 2 (SITE & LAB WATER) added to sample bottles with preservative and stored 150 ml each treatment (7 concentrations + control) * 2 (SITE & LAB WATER) filtered through 0.45 um filter, filtrate placed into sample bottles with preservative and stored Prepare equipment blank: 150 ml laboratory water filtered through 0.45 um filter, and filtrate placed into sample bottle containing preservative
	1530	CBI	TEST START: <ul style="list-style-type: none"> Organisms randomly placed into test chambers
4	1530	CBI	24-hour water quality measurements using first set of chemistry duplicates
5	1530-1730	CBI	TEST END: <ul style="list-style-type: none"> Animals counted/observed and findings recorded (LAB & SITE WATER) Water chemistry measured using second set of chemistry duplicates Filter through 0.45 um filter all 6 replicates from the following treatments (SITE & LAB water) and place into sample bottles with preservative: <ul style="list-style-type: none"> Controls All concentrations with partial mortalities The highest concentration with no adverse effects The lowest concentration with complete mortality Ship all metals samples T=0 and T=48 copper, and SITE and LAB water TOC, and TSS to ESS Laboratory Services for analyses

Detailed procedures for the preparation of the samples for copper analyses are described in CBI's Modifications to SOP ETS105 *Appendix 2*. The samples prepared by CBI will be transported to the analytical laboratory, where they will be analyzed for copper using Inductively Coupled Plasma (ICP), EPA Method 200.7. The DLS detection level for copper using ICP 200.7 is five (5) ug/L. The detection level of 2 ug/L is believed to be at least three (3) times lower than the copper concentrations that will be employed in the WER toxicity testing.

All samples to be analyzed for copper will be collected, preserved, and transported in accordance with appropriate QA/QC procedures and in a manner to minimize the potential for contamination.

2. Additional Analyses

Analyses that are planned for the WER study are presented in Table 2 on page 10. Analytical methods and detection levels that will be used with each parameter are presented in Table 3 on page 11. These analyses are being performed for one of the following reasons:

- They are required by the toxicity testing guidelines
- They are recommended by EPA guidelines for conducting a WER study
- They are parameters routinely measured and reported on the DMRs

Parameters Required by Toxicity Testing Guidelines or Recommended by WER Guidance.

Water quality parameters required by the toxicity testing guidelines are routinely monitored by CBI during the conduct of toxicity tests, and are discussed in CBI's SOP ETS105G and modifications to SOP ETS105, *Appendix 3*. In addition, EPA's WER Guidance (EPA-822-R-01-005) recommends that hardness, pH, alkalinity, TOC, TSS, and DOC be measured in the site water and/or laboratory dilution water. Chemistry controls" (or dummy replicates) will be used to obtain the required measurements in toxicity test solutions at 24-hours and 48-hours in order to avoid contamination.

DMR Parameters

In addition to the total copper analyses described in E.1 above, the following DMR parameters were analyzed at Outfall 001 during each sampling event: Flow, temperature, dissolved oxygen (DO), pH, biological oxygen demand (BOD), total suspended solids (TSS), E. Coli, hardness, orthophosphates, total phosphorous, total kjeldahl nitrogen (TKN), nitrate/nitrite (NO₂/NO₃), and total nitrogen (TN).

**RWSA SPERRYVILLE WWTP
WER Study 2010 Table 2**

SAMPLE DATE	7/5/2010	7/7/2010	8/2/2010	8/4/2010	8/19/2010
Flow (MGD)	0.0120		0.0089		
Parameters	Results in Mg/L	Results in Mg/L	Results in Mg/L	Results in Mg/L	Results in Mg/L
E.Coli	<1		<1		
TSS	1.34		3.4		
TOC	<1		<1		
NO2/NO3	31.7		38.9		
DOC	<1		<1		
BOD	2		<2		
Hardness	133		207		
Alkalinity	107		100		
OPO4	4.59		4.99		
TP	4.82		5.08		
Diss. Copper	0.015		0.018		
Total Copper	0.017		0.019		
NH3	0.61		0.17		
TKN	2.18		3.01		
TN	33.88		41.91		
TSS (SFW)		1.1		<1	
TSS (SITE)		1.8		2.51	
Total Copper (LC)		<0.002		<0.002	
Total Copper (L3)				0.013	
Total Copper (L4)		0.017		0.018	
Total Copper (L5)		0.025		0.025	
Total Copper (L6)		0.035		0.034	
Total Copper (L7)				0.050	
Total Copper (SC)		0.018		0.017	
Total Copper (S3)		0.168			
Total Copper (S4)		0.227		0.220	
Total Copper (S5)		0.315		0.302	
Total Copper (S6)				**0.632	
Total Copper (S7)				0.597	
TOC (SFW)		1		0.8	*1.6
DOC (SFW)		<0.5			*0.8
TOC (SITE)		6.2	*6.2	6.7	
DOC (SITE)		3.5	*4.3		
WER	8.042		6.029		

*Re-analysis of aliquot in HCL preservation for TOC and unpreserved for TOC

**Test concentrations were prepared as a serial dilution of the highest test concentration (S7) therefore all other tests concentrations would have been high. This anomaly is higher than S7 and logically cannot be explained. Therefore the LC50 was calculated using the nominal value for S6 of 420 ppb.

FINAL WER (Calculated Geometric Mean of Ratios)	6.963	
FINAL WER (Maximum Allowable WER From EPA)	5.000	
Current VPDES Permit Limit for Total Recoverable Copper	18	ug/L
Proposed VPDES Permit Limit for TR Copper Based On WER Study	90.00	ug/L

Table 3. Analytical Methods and Detection Levels for use in WER Study

Parameter	Analytical Method	LOD	LOQ	Units
Alkalinity	SM 2320 B	1	2	PPM
Biochemical Oxygen	SM 5210 B		2	PPM
Conductivity	SM 2510		1	PPM
Dissolved Copper	EPA Method 200.7	0.001	0.005	PPM
Dissolved Organic Carbon	SM 5310 C		1	PPM
Dissolved Oxygen	SM 4500 OG	0.1		PPM
E. Coli	SM 9223 B		2	MPN
Hardness	SM 2340C	1	2	PPM
Nirate/Nitrite	SM 4500 NO3F		0.05	PPM
Orthophosphate	SM 4500 PE	0.007	0.05	PPM
pH	SM 4500-H+ B			SU
Total Kjeldahl Nitrogen	SM 4500 NH3B	0.62	0.75	PPM
Total Nitrogen	Calculation			
Total Organic Carbon	SM 5310 C	0.2	1	PPM
Total Phosphorus	SM 4500 PBE	0.01	0.05	PPM
Total Recoverable Copper	EPA Method 200.7	0.001	0.005	PPM
Total Suspended Solids	SM 2540D		1	PPM

F. Calculation of the Water Effects Ratio and Site-Specific Criteria

The acceptability of each toxicity test will be evaluated individually. Tests with substantial deviations from the laboratory practices presented in the EPA WER guidance and/or EPA, ASTM, and CBI protocols for conduct of the tests will be rejected.

The LC₅₀s for laboratory and site water tests will be calculated using dissolved (mean) and total copper concentrations. The method employed for calculation of the LC₅₀ will be appropriate for the data, and the same computational methods (e.g., Probit, computational interpolation, etc.) will be employed for both tests from a particular sampling event. Guidelines for calculation of laboratory and site water EC₅₀s presented in Appendix A, Section G.3 and G.4 of EPA's Streamlined WER Guidance will be followed for calculation of the LC₅₀s in laboratory and site water, respectively.

The LC₅₀s determined for the laboratory water, site water, and the Species Mean Acute Value (SMAV) for *C. dubia* will be normalized to the same hardness. A sample WER will be determined for each pair of hardness-normalized LC₅₀ values as follows:

$$\frac{\text{LC}_{50} (\text{site water})}{\text{LC}_{50} (\text{laboratory water})^*}$$

*If the hardness-normalized laboratory water LC₅₀ is less than the hardness-normalized SMAV value for *C. dubia*, then the hardness-normalized SMAV value will be used.

The site WER will be calculated as the geometric mean of the two (or more) sample WERs. Site-specific dissolved copper criteria will then be calculated as Virginia's default dissolved copper criteria multiplied by the WER.

G. REPORTING

Following completion of the WER study RWSA will schedule a meeting with DEQ staff to review the results and the calculated WER. After the meeting, a report will be developed and provided to the DEQ that will include the following:

- Summary of the sampling and analytical procedures employed
- Summary of the analytical results
- Summary of QA/QC results, addressing data validation
- Discussion of the calculations used to derive the WER
- The final copper WER

H. INTERPRETATION OF WER RESULTS

Of the WER Study collection event that occurred on 7/5/10, site water yielded a WER of 9.082 for site water EC50 divided by lab water EC50, and a ratio of 8.042 for the site water divided by the Species Mean Acute Value from Appendix B of EPA Streamlined WER Procedures for Discharges of Copper. The lower of the two ratios was used in the calculation of the final ratio (geometric mean of both sampling events). See Table 4 below.

Of the WER Study collection event that occurred on 8/2/10, site water yielded a WER of 11.91 for site water EC50 divided by lab water EC50, and a ratio of 6.029 for the site water divided by the Species Mean Acute Value from Appendix B of EPA Streamlined WER Procedures for Discharges of Copper. The lower of the two ratios was used in the calculation of the final ratio (geometric mean of both sampling events). See Table 4 below.

Table 4
Study 1

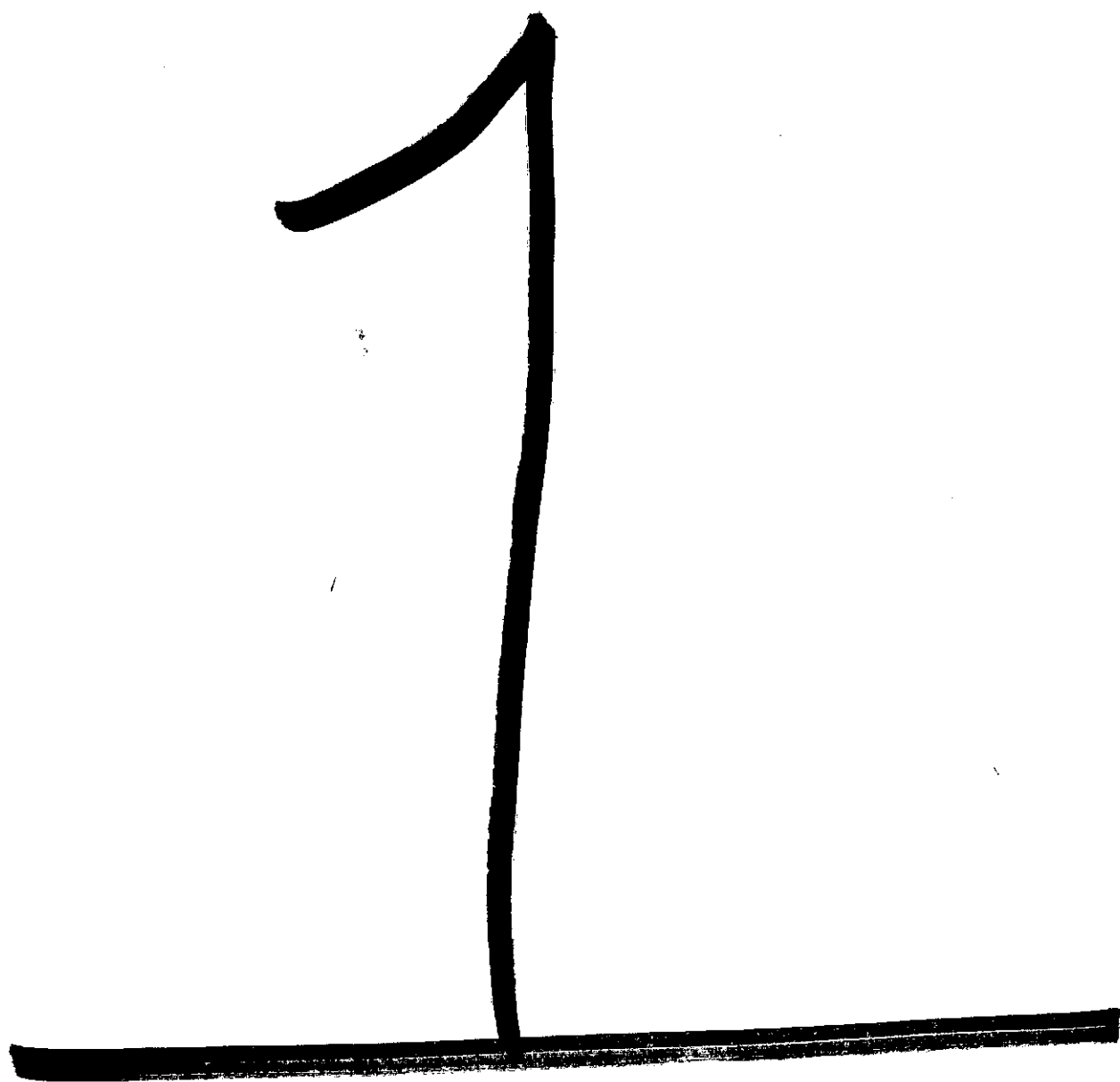
Test Matrix	48HR EC50 (ug/L)	95% C.L.	Test Hardness (mg/L CaCO3)	Normalized 48HR EC50 (ug/L)
Lab Water	28.53	27.13-29.68	132	28.53
Site Water	259.1	250.4-268.2	132	259.1
Chemical Basis	WER Denominator	Normalized Site Water EC50 (ug/L)	Normalized Lab or SMAV EC50 (ug/L)	WER
Total Copper	Lab Water	259.1	28.53	9.082
Total Copper	EPA 2001	259.1	32.22	8.042

Study 2

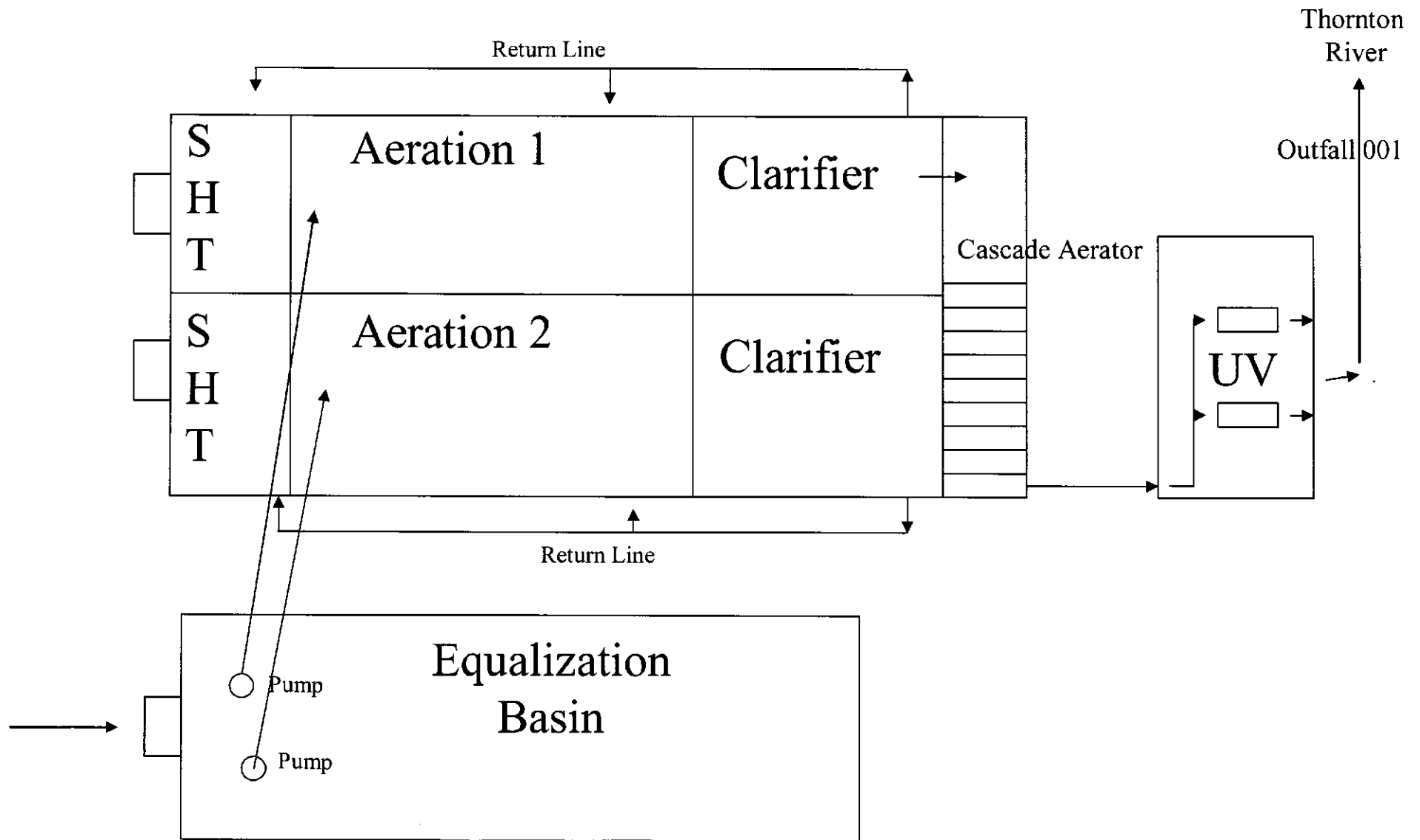
Test Matrix	48HR EC50 (ug/L)	95% C.L.	Test Hardness (mg/L CaCO3)	Normalized 48HR EC50 (ug/L)
Lab Water	23.12	21.62-24.73	198	23.34
Site Water	278.0	264.4-292.2	200	278
Chemical Basis	WER Denominator	Normalized Site Water EC50 (ug/L)	Normalized Lab or SMAV EC50 (ug/L)	WER
Total Copper	Lab Water	278	23.34	11.91
Total Copper	EPA 2001	278	46.11	6.029

Final WER	6.963
Maximum Allowable WER (EPA)	5.000
VPDES Copper Limit	18
Proposed VPDES Copper Limit with WER Applied	90

The WER for Sperryville WWTP has been calculated by using the geometric mean of the lowest ratios determined from 7/5/10 and 8/2/10, 8.042 and 6.029 respectively. The geometric mean of these two ratios is calculated as 6.963, however the maximum allowable ratio by EPA is 5.000. Therefore applying the WER of 5.000 to the current permitted limit for Copper of 18 ug/L yields a concentration of 90 ug/L.



Flow Diagram of Rappahannock Water and Sewer WWTP



2

Protocol for Collection and Handling of Water Samples for use in Rappahannock Water and Sewer Authority – Sperryville WWTP Water Effect Ratio (WER)

General Guidelines

Preliminary Considerations

1. All sample equipment will be cleaned and preserved by one of the following labs;
 - Environmental System Services
 - Coastal Bioanalysts
2. ESS will collect a monthly Hardness in the Thornton, at Outfall 001 until study has been completed.
3. ESS will provide analytical services for the Hardness and all other samples collected for TOC, and TSS.
4. **DMR Reporting-** All DMR required parameters measured in the field will be reported to ESS staff responsible for DMR completion in time to complete the DMR by the 8th of the month following collection.

Sampling Plan

1. ESS will perform two (2) sampling events to collect the WER samples.
2. Each WER sample will be collected with a peristaltic pump, using new vinyl tubing. Tubing will be flushed with approximately 1 gallon of wastewater prior to collection of samples.
3. Five (5) gallons will be collected in a new cubitainer filled to the top of the container, properly packaged in a cooler and preserved on ice. Cubitainers will be rinsed with sample prior to filling. The properly preserved and packaged carboy will be transported and relinquished to Coastal Bioanalyst Inc. (CBI), while maintaining the sample chain of custody.
4. ESS will collect the sample early during the day to allow the ESS technician to deliver the sample to CBI by 1500, the day of collection.

Water Effects Ratio Sampling Procedures

1. ESS arrive onsite.
2. ESS technicians set up peristaltic pump at sampling location Outfall 001.
3. At outfall 001 pH, Dissolved Oxygen, Conductivity, Flow, and Temperature measurements will be taken by an ESS technician. Of these parameters pH, Dissolved Oxygen, Flow, and Temperature are to be reported on the DMR.
4. Samples for TOC, TSS, Hardness, Alkalinity, DOC, Total Copper, Dissolved Copper, BOD, E. Coli, Orthophosphate, Total Phosphorus, TKN, NO₂/NO₃, and Total Nitrogen (Calculation of TKN+NO₂/NO₃) will be collected at outfall 001 in bottles provided by the analytical lab. Of these parameters BOD, TSS, E. Coli, Hardness, Orthophosphate, Total Phosphorus, TKN, NO₂/NO₃, and Total Nitrogen are to be reported on the DMR.
5. The technician will collect five (5) gallons of sample in a new cubitainer. This container will be preserved on ice in a cooler, then immediately transported to CBI.

The Contents of these Standard Operating Procedures (SOP's) are considered the property of Environmental Systems Service, Ltd. (ESS) and as such are confidential. No part of these procedures may be reproduced in any form, except as required for this specific project, without express written permission from ESS



5

Ceriodaphnia dubia ACUTE TEST

EPA 2002.0

UNCONTROLLED COPY

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 1 of 9

Controlled Copy# _____

APPROVED:



Peter F. De Lisle, Ph.D., Technical Director

5/9/07

NOTE: This Standard Operating Procedure contains proprietary information and was developed for the sole use of Coastal Bioanalysts, Inc. and shall not be used by other organizations, or distributed to other parties, without written approval from Coastal Bioanalysts, Inc.

Distribution:

1. Quality Assurance office file (Original hardcopy with records of review and distribution)
2. Controlled copies to appropriate personnel/laboratories.

Distribution records (Original copy only):

Copy #	To: Name/Location	Distrib. Date	QAO Init.	Return Date	QAO Init.
1	Lab				

Records of review (Original copy only):

_____ (Reviewed by)	_____ (Date)	_____ (Reviewed by)	_____ (Date)
_____ (Reviewed by)	_____ (Date)	_____ (Reviewed by)	_____ (Date)
_____ (Reviewed by)	_____ (Date)	_____ (Reviewed by)	_____ (Date)

Date removed from laboratory use:

(All controlled copies returned/destroyed by this date) _____ (Technical Director) _____ (Date)

*Methods must be reviewed at least annually by the quality assurance officer as part of the annual audit and managerial review. All affected staff reading a method for the first time should certify such in their personnel file.

***Ceriodaphnia dubia* ACUTE TEST**

EPA 2002.0

UNCONTROLLED COPY

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 2 of 9

Controlled Copy# _____

TEST METHOD

EPA 2002.0

APPLICABLE MATRICES

Aqueous. This species cannot tolerate highly saline matrices (NaCl NOEC is 1 g/l, LOEC 2 g/l).

DETECTION LIMIT

Not applicable to toxicity.

SCOPE AND APPLICATION

1. This test method measures the acute toxicity (LC50) of effluents to the freshwater cladoceran, *Ceriodaphnia dubia*, during 24-h to 48-h static or 48-h to 96-h static-renewal exposures. The method may also be used for determining the NOAEC without any modification of test design.
2. This test is used as a definitive test consisting of five effluent concentrations and a control. Other designs, such as testing 100% sample from each of several stations plus a control and/or reference site may be used for testing surface waters, elutriates, etc.
3. This version of this SOP incorporates NELAP-required elements; the actual conduct of the test method is unchanged from the previous version of the SOP (ETS105E, 2/18/03).

SUMMARY OF TEST METHOD

1. Daphnids (< 24-h old) are exposed to five different concentrations of an effluent during the 24-h or 48-h test. Pass/fail NOAEC tests use only a control and critical (e.g. 100%) effluent concentration. Multi-dilutional NOAEC tests are also often specified in permits.
2. Water quality is monitored daily. Tests may be static or static renewal and may be extended to 96 h duration with feeding and daily renewal or renewal at 48 h.
3. The number of live daphnids is also recorded daily. The test endpoint is survival.
4. Valid tests must have a minimum of 90% control survival. Refer to references below for additional information.

DEFINITIONS

Unless otherwise specified, the term effluent is used, for the sake of convenience, throughout this document to refer to effluents, ground waters, receiving waters, leachates, elutriates and other aqueous samples. See also DRS801 for additional definitions and terms.

INTERFERENCES

1. Excessive headspace or insufficient chilling of samples during shipment and storage may result in toxicity being underestimated.
2. Improper handling may adversely affect both organism and sample condition.
3. Indigenous organisms which may be predators or pathogens of the test organisms, or are similar in appearance to the test organisms, may confound toxicity test results.
4. pH drift during testing may result in artifactual toxicity of pH-dependent toxicant (e.g. metals, ammonia). See SOP ETS204 for pH control methods. Note: If results are to be used for compliance purposes modifications for pH control require approval of the regulatory authority before implementation.

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 3 of 9

Controlled Copy# _____

EPA 2002.0
UNCONTROLLED COPY

SAFETY, WASTE MANAGEMENT AND POLLUTION PREVENTION

1. Collection and use of effluents in toxicity tests may pose risks to personal safety and health. Standard laboratory safety procedures must be adhered to at all times. Gloves must be worn at all times when handling samples.
2. Effluents discharged under NPDES permits may be poured directly down the drain. Except for pH adjustment (> 5), all reagents used in this test and supporting analyses (e.g. ammonia, alkalinity, etc.) do not require any pre-treatment prior to discharge to the sanitary sewer.

EQUIPMENT AND SUPPLIES

1. Daphnids (< 24-h old), minimum of 150 (120 for test, 30 for "surrogate" chambers used for water quality measurements on day 1). Suppliers of brood stock (in order of preference):
 - a. Chesapeake Cultures (Elizabeth Wilkins 804-693-4046)
 - b. Aquatic BioSystems (Scott Kellman 800-331-5916)
 - c. Aquatic Research Organisms (800-927-1650)
2. YCT/*Selenastrum*
3. Temperature controlled (20 or 25 \pm 1 °C) lab
4. Light table
5. Calibrated thermometers
6. Test chambers, (30) 30-ml portion cups, scintillation vials, or equivalent; all identical
7. HDPE Template (Fig. 1)
8. Funnel, with 60 μ m mesh
9. Calibrated flasks, 250-ml
10. Wash bottles containing DI H₂O
11. Graduated cylinders 100-ml
12. Pipettes, pipette pumps and pipette bulbs
13. Tape, markers
14. Data sheets
15. Air lines, Pasteur pipettes and air stones

REAGENTS AND STANDARDS

1. DI H₂O (ASTM Type I)
2. Moderately hard standard synthetic freshwater
3. KCl Sigma Ultra grade

SAMPLE COLLECTION, SHIPMENT, STORAGE AND PREPARATION

Refer to SOP ETS201 regarding sample collection and shipment; this is usually the responsibility of the client or a subcontractor.

Samples must be properly stored and prepped prior to use in toxicity tests. Incorrect sample storage or prep may invalidate the test and/or affect test results. Refer to SOP SPLS202 and ETS203 for sample receipt and prep procedures.

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 4 of 9

Controlled Copy# _____

EPA 2002.0
UNCONTROLLED COPY

REQUIRED TEST CONDITIONS

TEST TYPE:	Static (24-h or 48-h), 48-h static-renewal, or 96-h static renewal (daily or at 48h). Permit specific. (Codes - Static: ACD Renewal: ACD - 48R, -96DR, -96R1)
TEST CONCENTRATIONS (%):	Depends upon WET limit or other permit limit. Permit may specify a dilution series. Dilution factor for effluents is $\geq 0.5X$ unless otherwise specified by regulatory authority or special test objectives. Typical: 100, 50, 25, 12.5, 6.25%. May also be NOAEC pass-fail test.
DURATION:	24 or 48 \pm 0.5 h; 96 \pm 0.5 h with renewal daily or at 48-h
REPLICATES:	4 with 5 animals each (i.e. 20 animals/concentration; LC50 & NOAEC tests)
RANDOMIZATION:	Test chambers oriented in randomized block design (DRS601)
TEST CHAMBERS:	Borosilicate glass scintillation vials, portion cups or equivalent
TEST VOLUME:	15 ml
TEMPERATURE:	25 \pm 1° C or 20 \pm 1° C (max-min 3° C maximum) (permit specific)
DILUTION WATER:	Standard synthetic freshwater (SFW), moderately hard ¹
PHOTOPERIOD:	16 h light/8 h darkness
LIGHT INTENSITY:	10-20 $\mu\text{E}/\text{m}^2/\text{s}$ (50-100 ft-c) (ambient laboratory illumination)
AGE:	< 24-h old
D.O.:	≥ 4.0 mg/l, do not aerate test chambers
FEEDING:	Feed YCT/ <i>Selenastrum</i> while holding (min. 2 hr) prior to test; not fed during 48-h test. For 96-h test feed 0.2 ml YCT/ <i>Selenastrum</i> mixture/beaker 2 h prior to renewal at 48 h
CLEANING:	Not required. New (clean) chambers used for renewals.
SAMPLE HOLDING TIME:	36 h first use, may be used for renewal for up to 72 h after first use
TEST ACCEPTABILITY:	$\geq 90\%$ control survival; test must not be prematurely terminated

¹ Dilution water may be of same hardness as the receiving water if known and approved by the regulatory authority. In some cases the receiving water may be used as the diluent (permit specific). Both a site-hardness SFW or receiving water control and a standard synthetic water control must be run.

***Ceriodaphnia dubia* ACUTE TEST**

EPA 2002.0

UNCONTROLLED COPY

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 5 of 9

Controlled Copy# _____

IMPORTANT NOTES:

Recording data:

1. Use only permanent ink, waterproof pen for all logbook and bench sheet entries.
2. Fill in information requested on bench sheets completely, on a real-time basis.
3. Write neatly and legibly.
4. Corrections to bench sheet entries must be performed by placing a single line through the incorrect entry, writing the corrected entry as near its appropriate space as possible and initialing the correction. Write an explanation of the error if needed (footnote with number if necessary due to space limitations).

Control of contamination:

Samples may contain bacteria or fungi which are pathogenic to test organisms, especially fathead minnows. To decrease the possibility of control or between-test pathogen or toxicant contamination:

1. Gloves must be worn whenever hands come in contact with effluent, dilution water, test vessels, etc.
2. Use a dedicated pipette for transferring animals for each test and for controls (Renewal tests).
3. Obtain Day 0 water quality measurements by pouring water from beakers used for sample prep into dedicated 30-ml beakers. Collect final water quality measurements from surrogate beakers (see Fig. 1) on Day 1 and from test beakers on Day 2 (test termination). Be careful not to splash or aerate sample during collection of aliquots.
4. Change pH probe soak daily, using a new container.

PROCEDURE & METHOD PERFORMANCE

Refer to the work order database to determine client (permit) specific test requirements such as dilution series, duration, dilution water, species and dechlorination and pH adjustment procedures. See SOP ETS203 for guidance on preparing dilutions.

Test Set Up (Day 0)

1. The test should be set up as soon as practical within sample holding time (36 h).
2. Test animals must all be from the same source and must have exhibited acceptable survival ($\geq 90\%$) during the previous 24-h period. Unacceptable survival can be identified by examining the brood board for dead adults among the group(s) of organisms being used for production of test neonates (e.g. 6-day and 7-day olds).
3. Collecting test organisms:
 - a. Record vials with offspring on brood board and time checked periodically during the afternoon, night and/or morning before the test is set up so that a sufficient number of animals can be collected which are all released within the 24-h period prior to the start of the test (see CULS002).
 - b. Select daphnids for test of appropriate age (<24 h at test set up) from animals with good brood sizes (>10) which have produced a minimum of 3 broods. Only select animals which appear to be in good health, i.e. swimming, good color, size and shape.
 - c. Pool animals in a bowl, feed YCT + *Selenastrum* mixture (ca. 2 ml/150 ml) and place bowl in test lab at least 2 hr. prior to test start up.
4. Select and label a template board (Fig. 1). Record brood release data (i.e. age), acclimation temperature, template number, etc. on bench sheet.
5. Prepare effluent sample, approximately 200 ml for a single *Ceriodaphnia*, more if additional species are to be tested (exact amount will also depend on the dilution series used; 200 ml based on 0.5 x dilution series). Record sample pH, temperature, conductivity and D.O. Note: Sample pH should be 6.0-9.0; if not, additional treatments may need to be set up. See Sample Preparation SOP ETS203 for detailed instructions.
6. Check dilution water to ensure acceptable temperature, conductivity, pH and D.O. and record measurements. Check that hardness and alkalinity measurements for the batch of dilution water are within specifications (SOP

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 6 of 9

Controlled Copy# _____

EPA 2002.0

UNCONTROLLED COPY

RWS001) and transcribe values and vat number from the batch sheet to the effluent/dilution water prep sheet for the test. Note: SFW diluent should not be used for more than two weeks. Note: If animals are cultured in a water different than that used for the test dilution water then a second control (culture water control) must be tested.

7. Because of the small volumes of water (15 ml) used, the test chambers must be thermally equilibrated to the test temperature prior to use.
8. Pour the control (dilution water only), using a separate, labeled and calibrated 250-ml flask. Fill to the 100 ml mark. Pour approximately 15 ml into each of 5 test chambers, placing on appropriate block on template. The fifth replicate is placed in the 5th row of the template (Fig. 1); this chamber will receive the requisite number of test organisms (5) but will be sacrificed on day 1 for water quality measurements (i.e. these animals are not counted for LC50 determination). These "surrogate chambers" are used to prevent contamination from probes and damage to animals.
9. Pour excess (~25 ml) into a 30-ml beaker for initial (day 0) water quality measurements. Make sure the 30-ml beakers are clean, dry and equilibrated to test temperature before use.
10. Pour the remainder of the test by measuring out the amount of effluent needed (using graduated cylinder or pipette as appropriate) into a labeled, pre-calibrated 250-ml flask and diluting to 100 ml calibration mark with SFW. Alternatively, serially dilute 200 ml by pouring off 100 ml portions working in order of decreasing concentrations. Mix, pour into test chambers (excess into 30 ml beakers) and place chambers in appropriate wells on template as described above. Record time test poured.
11. Immediately after pouring test solutions measure (in 30-ml beakers) and record, in order of increasing concentration:
 - a. Temperature, pH, conductivity and D.O. in one replicate of each concentration.
 - b. Total residual chlorine (TRC) in the highest concentration if present at sample check-in (also in dilution water if chlorine may be present; e.g. if a receiving water is used as diluent); record on effluent prep sheet.
 - c. Check that values make sense with respect to required test conditions, internal consistency and saturation values. Unusual values may indicate instrument drift since last calibration, measurement error, etc.
12. Transfer neonate daphnids, using a disposable pipette (watch daphnid exit pipette tip under water surface), one or two at a time, until there are 5 in each chamber. Only select animals which appear to be in good health, i.e. swimming, good color, size and shape; avoid undersize animals. Because the chambers are in random order and only one or two animals are placed in each chamber per time, this method insures healthy animals are randomly assigned to treatments. Verify that the correct number of animals are added to each chamber. Record time the daphnids are added, this is the time the test started. Animals should be added as soon as possible and no more than one hour from the time the test was poured.
13. Loosely cover chambers.
14. Check survival in the highest concentration approximately 1 h after test is set up. If mortality is observed at that time additional, lower, test concentrations may have to be set up (e.g. 3.13 and 1.56%). The number of additional concentrations should be based on the extent of mortality observed in lower test concentrations.
15. Rinse 30 ml beakers well with deionized water and invert to dry (in test lab to insure thermal equilibration) for use the next day.
16. Prepare dilution water as needed to be used the following day (Renewal tests)

Daily Tasks (Day 1 (or 2 and 3))

Static Tests:

1. Measure and record, in order of increasing concentration, temperature, pH, and D.O. in the fifth (surrogate) replicate of each concentration. Discard solution after measurement. Check that values make sense with respect to previous day's values, concentrations, saturation values, required conditions, etc. Unusual values may indicate instrument drift since last calibration, measurement error, etc.

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 7 of 9

Controlled Copy# _____

EPA 2002.0

UNCONTROLLED COPY

2. Count and record the number of live daphnids. Record time, and initials. Remove any dead animals. NOTE: Although dead bodies may sometimes dissolve they usually don't. Verify live count + dead count = previous day total.

Static-Renewal Tests: (Note: If a 96-h test feed 0.2 ml YCT/*Selenastrum* concentrate/chamber 2 h before renewal at 48 h)

1. Prepare effluent sample as above.
2. Check dilution water to ensure acceptable temperature, conductivity, pH and D.O. and record measurements. Check that hardness and alkalinity measurements for the batch of dilution water are within specifications (SOP RWS001) and transcribe values and vat number from the batch sheet to the effluent/dilution water prep sheet for the test.
3. Prepare each concentration separately, pour into a new set of test chambers (see sect. 8-10 above).
4. Collect "initial" (after renewal; on aliquots from prep flasks) measurements for each concentration:
 - a. Temperature, pH, conductivity and D.O. in one replicate of each concentration.
 - b. Total residual chlorine (TRC) in the highest concentration and control if present at test initiation
 - c. Check that values make sense with respect to required test conditions, internal consistency and saturation values. Unusual values may indicate instrument drift since last calibration, measurement error, etc.
5. Count the number of survivors as daphnids are transferred (watch daphnids exit pipette tip, placed under water surface) into new solutions; verify (recount) after transfer. Place the chamber with daphnid and fresh solution back on the test board in the correct well. Be careful not to slosh water, causing the daphnids to stick to the wall of the vessel. Record time of transfer, number of survivors and initials.
6. Measure and record in old solutions "final" (before renewal) water quality parameters:
 - a. Temperature, pH, and D.O. in one replicate of each concentration.
 - b. Total residual chlorine (TRC) in the highest concentration and control if present at test initiation
 - c. Check that values make sense with respect to required test conditions, internal consistency and saturation values. Unusual values may indicate instrument drift since last calibration, measurement error, etc.

*Highest test concentration with surviving animals in the period 24 h prior to measurement.

Termination of Test (48±0.5 h or 96±0.5 h)

1. Count and record the number of live daphnids. Record time and initials. NOTE: Although dead bodies may sometimes dissolve they usually don't. Verify live count + dead count = previous day total.
2. Measure and record, before renewal, in order of increasing concentration:
 - a. Temperature, pH and D.O. in one replicate of each concentration.
 - b. Conductivity in the highest concentration and control.
 - c. Total residual chlorine (TRC) in the highest concentration and control if present at test initiation
 - d. Check that values make sense with respect to required test conditions, internal consistency and saturation values. Unusual values may indicate instrument drift since last calibration, measurement error, etc.
3. Remove all test glassware to wash area. Discard any remaining sample. If sample needs to be saved for later chemical analysis, mark the container (red tape on cap) to indicate it is an archived sample.

CALCULATIONS AND DATA ANALYSIS

1. For all treatments and controls calculate the percent total survival.
2. The TAC and statistics are determined using performance of animals in the dilution water control; if a culture water or similar control is included its purpose is only to evaluate the appropriateness of the dilution water.
3. Refer to SOPs DRS101 and DRS102 for calculation and data analysis procedures:
 - a. For LC50 tests calculate the LC50 using appropriate method (SOP DRS101).

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 8 of 9

Controlled Copy# _____

EPA 2002.0
UNCONTROLLED COPY

- b. For pass-fail NOAEC tests evaluate the critical concentration using hypothesis testing (e.g. Student's t-test; SOP DRS102)
- c. For multi-dilutional NOAEC tests evaluate the critical concentration using hypothesis testing and calculate the LC50 if sufficient mortality occurs.

QUALITY CONTROL/DATA ASSESSMENT & ACCEPTANCE CRITERIA

1. Test acceptability criteria (TAC): Valid tests must have a minimum of 90% control survival. The TAC and statistics are determined using performance of animals in the dilution water control; if a culture water or similar control is included its purpose is only to evaluate the appropriateness of the dilution water. In addition, the test must be conducted in accordance with specified test conditions (temperature, test organism age, etc.; see below). Tests must not be terminated prematurely (i.e. ± 0.5 h).
2. All supporting activities, such as preparation of dilution water, balance use and calibration, etc., must be performed in strict accordance with laboratory SOPs.
3. A test may be deemed conditionally acceptable if there are minor deviations from specified conditions; determination of conditional acceptance based on degree of departure and objectives of test shall be made by the laboratory technical director and/or permitting authority and noted in the final report.
4. Reference toxicant tests must be performed each month the method is performed. If animals are purchased from an outside source a concurrent reference toxicant test must be conducted with the same batch of animals used in the effluent test. These tests are conducted similar to effluent tests except that a standard dilution series is tested using a concocted "100% effluent" composed of the reference toxicant (KCl) and laboratory dilution water (see below).

Reference Toxicant Test Concentrations/Dilutions:

1. Prepare "100%" concentration by dissolving 572 mg of KCl (Sigma "Ultra" grade, current lot in use) in 500 ml of SFW dilution water. Record KCl "A" number on bench sheet. Use a calibrated flask, initially adding the KCl to ca. 400 ml of dilution water and then bringing to 500 ml volume after complete dissolution of the reference toxicant. Mix well.
2. Test the following concentrations of "100%" reference toxicant sample: 100%, 70%, 49%, 34.3%, 24.0%; i.e. a 0.7X dilution factor. These correspond to 1144, 800, 560, 392 and 275 mg/l KCl.
3. The test must be performed using the same procedures as for a static effluent test.

OUT-OF-CONTROL/UNACCEPTABLE DATA: CORRECTIVE ACTIONS AND CONTINGENCIES

Immediately notify the QA officer if data are out of control limits or unacceptable.

CALIBRATION AND STANDARDIZATION

Calibration is not applicable to toxicity testing. See QSS301 and QSS302 for precision estimation and standardization using reference toxicants and PT samples.

REFERENCES

See Quality Manual

***Ceriodaphnia dubia* ACUTE TEST**

Coastal Bioanalysts, Inc.

SOP ETS105G

Effective Date 6/30/07

Page 9 of 9

Controlled Copy# _____

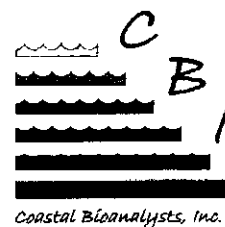
EPA 2002.0
UNCONTROLLED COPY



Fig. 1. Acute *Ceriodaphnia* test template. Rear row is for surrogate vessels for Day 1 water quality measurements.

4

Client: Environmental Systems Service, LTD.
Project ID: ESSL1014
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 7/5/10



REPORT: RAPPAHANNOCK WSA - COPPER WER (ROUND 1)

Submitted To: Ms. Angie Woodward Environmental Systems Service, LTD. 218 North Main Street, P.O. Box 520 Culpeper, VA 22701	Prepared By: Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director
--	---

METHODS:

Procedures followed the previously submitted and approved study plan. Test methods are summarized below. Details regarding test conduct and data analysis are provided in attached bench sheets and printouts as applicable.

Test Organisms

Six and seven days prior to testing *Ceriodaphnia dubia* cultures were started in hard synthetic freshwater (SFW; 155 mg as CaCO_3) using neonate cladocerans. This hardness corresponded to that expected for the effluent. Cultures were fed YCT-*Selenastrum* (@ 3.5×10^7 cells/ml) at a rate of 0.1 ml of each per 15 ml of culture solution. Production and survival of animals raised in the hard water appeared similar to that of standard lab cultures maintained in moderately hard SFW.

Test animals were < 24 h old and selected from females that had produced 3 or more broods with a minimum of 15 offspring produced by the third brood. Animals were not fed during the test but were fed YCT-*Selenastrum* approximately 4.5 h prior to use in tests.

Test Solutions

Hard SFW was prepared according to the EPA recipe by dissolving ACS reagent-grade (or better) salts in high purity deionized water followed by aeration for at least 24 h. The water was then diluted to the desired hardness using deionized water. Deionized water was obtained from a Barnstead Nannopure Research Series system. The following treatment train was used for the feed water provided to the Barnstead system: well water > 10 um particle > softener > 1 um particle > activated carbon > reverse osmosis > mixed bed anion-cation exchange > 1 um particle > Barnstead Nannopure.

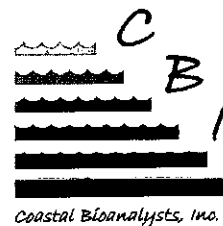
Effluent sample was stored at 3-4° C in the dark until used. Sample was maintained in collapsed Cubitainers with minimal headspace. Effluent was warmed to test temperature prior to use. Minimal (1 min) aeration was necessary to reduce oxygen to saturation concentration for range-finding and definitive tests.

Range-finding tests were used to determine appropriate concentrations for use in definitive toxicity tests. For the range-finding tests copper was added directly to site water and then serially diluted to prepare test solutions. "Site water" consisted of 100% undiluted effluent (based on stream and plant permitted design flow). The lab-water test solutions were similarly prepared by serially diluting spiked hard SFW. Copper was added as a $1 \mu\text{g}/\mu\text{l}$ (1 mg/ml) stock solution prepared by dissolving 67 mg of ACS reagent-grade $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ (99.999+%; Aldrich lot #15726CH) in 25 ml high purity deionized water. The same stock was used for all tests.

For the definitive site water test, copper was added to the effluent (site water) and allowed to equilibrate for 3 h prior to adding animals. A 2 L volume of the highest concentration of spiked effluent was prepared by adding 1200 μl of copper stock solution. Thus the final concentration was 600 $\mu\text{g}/\text{l}$ (assuming no background Cu). Serial dilutions (0.7X) of spiked site water were prepared by pouring off an 600 ml aliquot of the highest concentration and bringing



Client: Environmental Systems Service, LTD.
Project ID: ESSL1014
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 7/5/10



back to volume with un-spiked effluent. The 600 ml aliquots were added to labeled 1 L plastic beakers. The procedure was repeated to prepare seven beakers of solution of decreasing concentration. A control beaker received 600 ml of un-spiked effluent. The beakers were then allowed to stand for 3 h before being used in tests.

For the definitive lab water test 2 L of the highest concentration of hard SFW was prepared by spiking with 100 μ l of copper stock solution (final concentration 50 μ g/l). Serial dilutions (0.7X) of the spiked lab water were prepared as described above except using hard SFW as the diluent. The lab water solutions were then allowed to stand for 3 h before being used in tests.

Chemical Analyses

Samples of hard SFW and effluent were collected at the beginning of the test for TOC, TSS, and DOC analyses. Samples were stored at 3-4° C in the dark until shipped later with copper samples for analyses. Samples (approx. 200 ml) were collected from each treatment at the beginning of the test for total Cu. Total Cu samples were poured directly into sample containers. Copper samples from both the lab and site tests, as well as TOC and DOC samples, were sent to Reed and Associates (Newport News, VA) for analysis. TSS samples were sent to ESS for analysis. All sampling supplies were provided by the chemistry labs.

Measurements of dissolved oxygen, pH, temperature, conductivity, total residual chlorine, hardness, alkalinity and ammonia were performed using EPA methods. Instruments and titrations were calibrated using standards and/or titrants traceable to NIST where applicable.

Toxicity Tests

Toxicity test methods followed EPA Method 2002.0 (Acute *Ceriodaphnia dubia*). Toxicity tests were conducted using 1 oz. plastic shot glasses rather than borosilicate glass to decrease adsorption of Cu to vessel walls. Six replicates of 5 animals and 25 ml of solution were tested. In addition, two dummy replicates (rather than one) were included for water quality measurements (D.O., pH, temperature, conductivity) at T=24 h and T=48 h. These "chemistry controls" were loaded with test animals in the same manner as actual test chambers. Test chambers were arranged in a randomized block design prior to addition of animals and throughout the test.

Calculations

Following the EPA WER guidelines (EPA, 1994) four significant figures were retained in all calculations and endpoints to prevent round-off error. EC50s were calculated using the ToxCalc (version 5.0.23) software.

EC50s for lab and site water tests were calculated using nominal and measured total Cu. Because the probit method could not be used for both sets of tests, the Trimmed Spearman-Kärber method was used for all computations of measured Cu toxicity.

EC50 values are typically normalized to a standard (test) hardness based on the WER guidance formula (see EPA 2001):

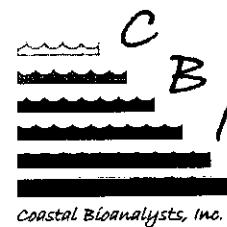
$$EC50_{\text{Standard Hardness}} = EC50_{\text{Test Hardness}} \times (\text{Standard Hardness/Test Hardness})^{0.9422}$$

Because the hardness values of the dilution and site waters were identical, EC50s did not need to be normalized to a similar hardness. However, for WER calculations, the hardness-adjusted Species Mean Acute Value (SMAV) was based on the value calculated at the criteria reference hardness (CRH, 100 mg/l) and published in the WER guidance document (24.0 μ g/l total; EPA2001). The following formula (from EPA 2001) was used to normalize the SMAV value to the test standard hardness of 132 mg/l:

$$SMAV_{\text{Test Hardness}} = SMAV_{\text{CRH (100)}} \times (\text{Test Hardness}/100 \text{ mg/l})^{0.9422}$$



Client: Environmental Systems Service, LTD.
 Project ID: ESSL1014
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 7/5/10



RESULTS:

Table 1. EC50 values (Total Cu)

Test Matrix	48-h EC50 ($\mu\text{g/l}$)	95% C.L.	Test Hardness (mg/l CaCO_3)	Normalized* 48-h EC50 ($\mu\text{g/l}$)
Lab Water:	28.53	27.43-29.68	132	28.53
Site Water:	259.1	250.4-268.2	132	259.1

*Normalized to a standard hardness of 132 mg/l (as CaCO_3).

Table 2. Calculated WER values.

Chemical Basis	WER Denominator Basis*	Normalized Site Water EC50 ($\mu\text{g/l}$)	Normalized Lab or SMAV EC50 ($\mu\text{g/l}$)	WER
Total Copper	Lab Water	259.1	28.53	9.082
	EPA 2001	259.1	32.22	8.042

*NOTE: EPA (2001) states "If the hardness-normalized EC50 in laboratory water is less than the documented SMAV for the species (i.e. EPA 2001 value), then use the SMAV in place of the laboratory water EC50 in the dominator of the WER"

Table 3. Biological and Chemical Summary Data - Lab Water Test

Total Cu ($\mu\text{g/l}$)		Survival (%)	
Nominal	Measured	24-h	48-h
0*	<2	100	100
5.88	ND	100	100
8.40	ND	100	100
12.0	ND	100	96.7
17.2	17	100	100
24.5	25	100	90
35.0	35	100	0
50.0	ND	0	0

*Lab Control (hard synthetic freshwater)



Client: Environmental Systems Service, LTD.
 Project ID: ESSL1014
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 7/5/10

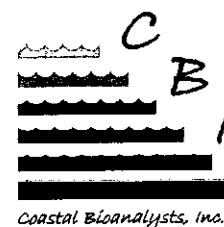


Table 4. Biological and Chemical Summary Data – Site Water Toxicity Tests

Total Cu (µg/l)			Survival (%)	
Nominal	Nominal + Background	Measured	24-h	48-h
0*	18	18	100	100
70.6	88.6	ND	100	100
101	119	ND	100	96.7
144	162	168	100	100
206	224	227	100	90
294	312	315	0	0
420	438	ND	0	0
600	618	ND	0	0

*Site Control (100% un-spiked effluent)

Table 5. Test Set-up Information

Test Matrix	Definitive Test Start Date/Time End Date/Time	Organism Source	Brood Release Date/Time	Acclimation Temp.	Acclimation Water	Test Aerated?
Lab Water	7/7/10 1430 7/9/10 1420	CBI Stock	7/6/10 1640 7/7/10 1000	25° C	Hard SFW	No
Site Water	7/7/10 1430 7/9/09 1425	CBI Stock	7/6/09 1640 7/7/09 1000	25° C	Hard SFW	No

Table 6. Lab and Effluent Water Quality Data

Water Quality Parameter (Units)	Lab Water	Effluent
Arrival Temperature (°C)	N/A	1
Use Temperature (°C)	25	25
Conductivity (µS/cm)	482	625
pH (S.U.)	8.17	7.84
Dissolved Oxygen (mg/l)	8.2	8.2
Total Hardness (mg/l as CaCO ₃)	132	132
Alkalinity (mg/l as CaCO ₃)	73	91
DOC (mg/l)	<0.5	3.5
TOC (mg/l)	1.0	6.2
TSS (mg/l)	1.1	1.8
Total Residual Chlorine (mg/l)	N/A	<Q.L.
Ammonia (mg/l NH ₃ -N)	<1.0	<1.0



Client: Environmental Systems Service, LTD.
 Project ID: ESSL1014
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 7/5/10

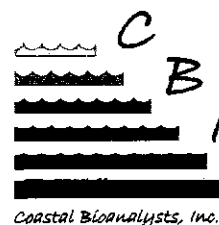


Table 7. Sample Aging/Use/Pretreatment

CBI Sample I.D.	Collection Date/Time	Date(s)/Time(s) Used in Range Tests	Date(s)/Time(s) Used in Definitive Tests	Sample Adjustments
ESSL1014-A	7/5/10 0635-1035	7/5/10 1550	7/7/10 1430 (lab), 1430 (site)	Aerated 1 min

Table 8. Lab Water Test - Water Quality (Mean/Std. Dev.)

Nominal Cu (µg/l):	Cont.	5.88	8.40	12.0	17.2	24.5	35.0	50.0
Temp. (°C)	25 0	25 0	25 0	25 0	25 0	25 0	25 0	25 0
D.O. (mg/l)	8.2 0	8.2 0	8.2 0	8.2 0.1	8.2 0.1	8.2 0	8.2 0	8.2 0
PH (S.U.)	8.04 0.16	8.05 0.16	8.06 0.17	8.05 0.17	8.03 0.23	8.03 0.23	8.02 0.24	8.02 0.25

Table 9. Site Water Test - Water Quality (Mean/Std. Dev.)

Nominal Cu (µg/l):	Cont.	70.6	101	144	206	294	420	600
Temp. (°C)	25 0	25 0	25 0	25 0	25 0	25 0	25 0	25 0
D.O. (mg/l)	8.2 0	8.2 0.1	8.2 0.1	8.2 0.1	8.1 0.2	8.1 0.2	8.1 0.2	8.2 0.1
PH (S.U.)	8.23 0.05	8.23 0.05	8.23 0.06	8.23 0.06	8.23 0.06	8.22 0.05	8.21 0.05	8.22 0.08

Table 10. Reference Toxicant Test Data
 (Reference Toxicant: KCl; Units: mg/l; CBI Stock Cultures)

Species-Method (Ref. Test Date)	Data Source	% Control Survival	48-h EC50	95% C.L./A.L. For EC50	RTT in Control?
<i>C. dubia</i> 2002.0 (7/1/10-7/3/10)	RTT	100	646	616-678	Yes
	CC	100	581	501-661	

Note: RTT = Reference Toxicant Test, CC = Control Chart.

DISCUSSION:

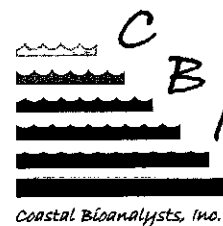
A WER value of 8.042 is obtained based on the ratio of the site EC50 to the hardness-adjusted SMAV.

LITERATURE CITED:

EPA 1994. *Interim Guidance on Determination and Use of Water-effects Ratios for Metals*. February 1994. EPA-823-B-94-001.



Client: Environmental Systems Service, LTD.
Project ID: ESS1014
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 7/5/10



EPA 2001. Streamlined Water-Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005. United States Environmental Protection Agency, Office of Water, March 2001.

GLOSSARY OF TERMS AND ABBREVIATIONS:

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

EC50/LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival or mobilization. The lower the EC50/ LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 or EC50 value must always be associated with the duration of exposure.

N/A: Not applicable. **N/D:** Not determined or measured.


Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

Species Mean Acute Value (SMAV): Mean value of hardness-normalized EC50 values. Used in the criteria document for calculation of water quality criteria.

Water-Effect Ratio (WER): A criteria adjustment factor accounting for the effect of site-specific water characteristics on pollutant bioavailability and toxicity to aquatic life (from EPA 2001).

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED:


Peter F. De Lisle, Ph.D.
Technical Director

7/26/10
Date

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**



CERIODAPHNIA DUBIA STATIC ACUTE TEST - WER
FORM ETF1051WER

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

Parameter	Treatment I.D.	Day 0	Day 1	Day 2
Temp. (°C)	C	25	25	25
	1	25	25	25
	2	25	25	25
	3	25	25	25
	4	25	25	25
	5	25	25	—
	6	25	25	—
	7	25	25	—
pH (S.U.)	C	7.87	8.17	8.09
	1	7.87	8.17	8.12
	2	7.87	8.19	8.12
	3	7.87	8.19	8.16
	4	7.87	8.19	8.13
	5	7.87	8.19	—
	6	7.85	8.19	—
	7	7.84	8.19	—
D.O. (mg/l)	C	8.2	8.2	8.2
	1	8.2	8.2	8.2
	2	8.2	8.2	8.2
	3	8.2	8.2	8.1
	4	8.2	8.2	8.1
	5	8.2	8.2	—
	6	8.2	8.2	—
	7	8.2	8.2	—
Conduct. (Us/cm)	C	687	—	667
	1	687	—	—
	2	687	—	—
	3	687	—	—
	4	687	—	694
	5	686	—	—
	6	686	—	—
	7	687	679	—
Replicate Meas.:		S	S	S
Initials:		PA	PA	GA
TRC (mg/l) in highest conc. at end of test:				NA

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ☒

Other: _____

Brood Date/time start: 7/6/10 1640

Release: Date /time end: 7/7/10 1000

Acclimation: Water: Mod. hard syn. FW

Other: 155 mg/L HD SPW

Temperature (°C): 25

Feeding: Prior to test: YCT/Selenastrum
During test: Not Fed

Illumination: 16L:8D 10-20 uE/m²/s

Test chamber size: 30 ml

Solution volume: 15 ml

Number of replicates/treatment: 6

Initial number of daphnids/replicate: 5

Template number: NA

Set up: Date (Day 0): 7/7/10

Time water added: 1130

Time daphnids added: 1430

Set up by (initials): PA/GA

Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival	Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Control	C-a	5	5	5	100	206	4-a	5	5	5	90
	C-b	5	5	5			4-b	5	5	5	
	C-c	5	5	5			4-c	5	5	3	
	C-d	5	5	5			4-d	5	5	4	
	C-e	5	5	5			4-e	5	5	5	
	C-f	5	5	5			4-f	5	5	5	
70.6	1-a	5	5	5	100	294	5-a	5	0	0	0
	1-b	5	5	5			5-b	5	0	0	
	1-c	5	5	5			5-c	5	0	0	
	1-d	5	5	5			5-d	5	0	0	
	1-e	5	5	5			5-e	5	0	0	
	1-f	5	5	5			5-f	5	0	0	
101	2-a	5	5	5	96.7	420	6-a	5	0	0	0
	2-b	5	5	5			6-b	5	0	0	
	2-c	5	5	5			6-c	5	0	0	
	2-d	5	5	4			6-d	5	0	0	
	2-e	5	5	5			6-e	5	0	0	
	2-f	5	5	5			6-f	5	0	0	
144	3-a	5	5	5	100	600	7-a	5	0	0	0
	3-b	5	5	5			7-b	5	0	0	
	3-c	5	5	5			7-c	5	0	0	
	3-d	5	5	5			7-d	5	0	0	
	3-e	5	5	5			7-e	5	0	0	
	3-f	5	5	5			7-f	5	0	0	
						Initials:	CB	PB	CB		
						Count Time:	1430	1040	1425	*Test end time	

Peer Rev by: AG Date: 7/26/10

0.7 x Dilution Factor (2L highest conc.; pour to 600 ml each dilution)

Highest conc = 1200 µl Cu stock in 2L effluent.

Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 7/7/2010 14:30 Test ID: ESSL1014 Sample ID: RAPPAHANNOCK WSA
 End Date: 7/9/2010 14:25 Lab ID: CBI Sample Type: SITE WATER
 Sample Date: Protocol: EPAA 91-EPA Acute Test Species: CD-Ceriodaphnia dubia
 Comments:

Conc-ug/L	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
70.6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
101	1.0000	1.0000	1.0000	0.8000	1.0000	1.0000
144	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
206	1.0000	1.0000	0.6000	0.8000	1.0000	1.0000
294	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
420	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

NOMINAL CU

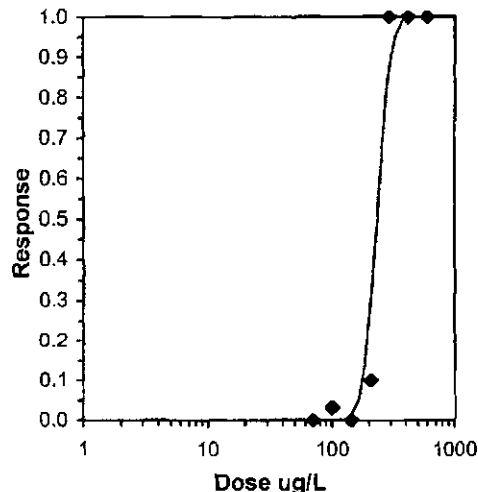
Transform: Arcsin Square Root							Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	0	30
70.6	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	0	30
101	0.9667	0.9667	1.3056	1.1071	1.3453	7.446	1	30
144	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	0	30
206	0.9000	0.9000	1.2291	0.8861	1.3453	15.715	3	30
294	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	30	30
420	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	30	30
600	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	30	30

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.68654	0.9	-2.2143	7.33602
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit											
Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	10.9367	20.7364	-42.368	64.2413	0	699.842	11.0705	5.3E-149	2.36091	0.09144	7
Intercept	-20.821	49.0137	-146.81	105.173							

Point	Probits	ug/L	95% Fiducial Limits
EC01	2.674	140.668	
EC05	3.355	162.371	
EC10	3.718	175.278	
EC15	3.964	184.561	
EC20	4.158	192.288	
EC25	4.326	199.174	
EC40	4.747	217.641	
EC50	5.000	229.565	
EC60	5.253	242.142	
EC75	5.674	264.593	
EC80	5.842	274.069	
EC85	6.036	285.543	
EC90	6.282	300.666	
EC95	6.645	324.566	
EC99	7.326	374.641	

Significant heterogeneity detected ($p = 5.31E-149$)



Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 7/7/2010 14:30	Test ID: ESSL1014A	Sample ID: MEASURED CU
End Date: 7/9/2010 14:25	Lab ID: CBI	Sample Type: SITE WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

Comments:

Conc-ug/L	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
168	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
227	1.0000	1.0000	0.6000	0.8000	1.0000	1.0000
315	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
168	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
227	0.9000	0.9000	1.2291	0.8861	1.3453	15.715	6	3	30
315	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

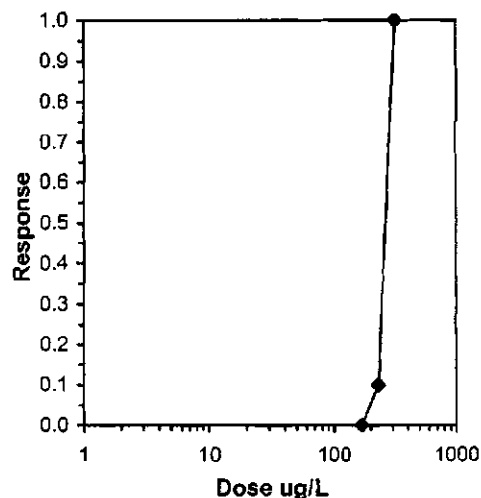
Auxiliary Tests

Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.67587	0.858	-2.0659 6.68443

Equality of variance cannot be confirmed

Trimmed Spearman-Kärber

Trim Level	EC50	95% CL	
0.0%	259.13	250.36	268.21
5.0%	261.62	250.66	273.05
10.0%	262.58	256.83	268.46
20.0%	262.58	256.83	268.46
Auto-0.0%	259.13	250.36	268.21



CERIODAPHNIA DUBIA STATIC ACUTE TEST - WER
FORM ETF1051WER

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

Parameter	Treatment I.D.	Day 0	Day 1	Day 2
Temp. (°C)	C	25	25	25
	1	25	25	25
	2	25	25	25
	3	25	25	25
	4	25	25	25
	5	25	25	25
	6	25	25	25
	7	25	25	—
pH (S.U.)	C	8.17	8.26	8.25
	1	8.17	8.24	8.25
	2	8.17	8.28	8.25
	3	8.17	8.28	8.25
	4	8.17	8.28	8.25
	5	8.17	8.26	8.23
	6	8.17	8.26	8.21
	7	8.16	8.28	—
D.O. (mg/l)	C	8.2	8.2	8.2
	1	8.2	8.2	8.1
	2	8.2	8.2	8.1
	3	8.2	8.1	8.0
	4	8.2	8.1	7.9
	5	8.2	8.2	7.9
	6	8.2	8.1	7.9
	7	8.2	8.1	—
Conduct. (µS/cm)	C	481	—	498
	1	482	—	—
	2	482	—	—
	3	482	—	—
	4	482	—	—
	5	482	—	—
	6	481	—	503
	7	482	482	—
Replicate Meas.:		S	S	S
Initials:		PA	PB	RA
TRC (mg/l) in highest conc. at end of test:				NA

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ☒

Other: _____

Brood Date/time start: 7/6/10 1640

Release: Date /time end: 7/7/10 1000

Acclimation: Water: Mod. hard syn. FW

Other: 155 mg/L NO₃-N

Temperature (°C): 25

Feeding: Prior to test: YCT/Selenastrum
During test: Not Fed

Illumination: 16L:8D 10-20 µE/m²/s

Test chamber size: ☒ 30 ml

Solution volume: ☒ 15 ml _____ ml

Number of replicates/treatment: 6

Initial number of daphnids/replicate: 5

Template number: NA

Set up: Date (Day 0): 7/7/10

Time water added: 1130

Time daphnids added: 1430

Set up by (Initials): PA/RA

Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival	Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Control	C-a	5	5	5	100	17.2	4-a	5	5	5	100
	C-b	5	5	5			4-b	5	5	5	
	C-c	5	5	5			4-c	5	5	5	
	C-d	5	5	5			4-d	5	5	5	
	C-e	5	5	5			4-e	5	5	5	
	C-f	5	5	5			4-f	5	5	5	
5.88	1-a	5	5	5	100	24.5	5-a	5	5	5	90 93.3 PSP 7/9/10
	1-b	5	5	5			5-b	5	5	5	
	1-c	5	5	5			5-c	5	5	4	
	1-d	5	5	5			5-d	5	5	4	
	1-e	5	5	5			5-e	5	5	5	
	1-f	5	5	5			5-f	5	5	4	
8.40	2-a	5	5	5	100	35.0	6-a	5	5	0	0
	2-b	5	5	5			6-b	5	5	0	
	2-c	5	5	5			6-c	5	5	0	
	2-d	5	5	5			6-d	5	5	0	
	2-e	5	5	5			6-e	5	5	0	
	2-f	5	5	5			6-f	5	5	0	
12.0	3-a	5	5	5	96.7	50.0	7-a	5	0	0	0
	3-b	5	5	5			7-b	5	0	0	
	3-c	5	5	5			7-c	5	0	0	
	3-d	5	5	5			7-d	5	0	0	
	3-e	5	5	5			7-e	5	0	0	
	3-f	5	5	840			7-f	5	0	0	
OGB TRAIL						Initials:		CB	PB	CB	*Test end time
						Count Time:		1430	1030	1420	

Peer Rev by: AG Date: 7/26/10

0.7 X Dilution factor (2 L highest concentration; pour off 600 ml each dilution)

Highest conc = 100 µl Cu stock in 2 L SPW.

Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 7/7/2010 14:30	Test ID: ESSL1014A	Sample ID: RAPPAHANNOCK WSA 001
End Date: 7/9/2010 14:20	Lab ID: CBI	Sample Type: LAB WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

Comments:

Conc-ug/L	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	
5.88	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8.4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	0.8000
17.2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
24.5	1.0000	1.0000	0.8000	0.8000	1.0000	0.8000
35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

NOMINAL CU

Transform: Arcsin Square Root								Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	5	0	25
5.88	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
8.4	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
12	0.9667	0.9667	1.3056	1.1071	1.3453	7.446	6	1	30
17.2	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
24.5	0.9000	0.9000	1.2262	1.1071	1.3453	10.637	6	3	30
35	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

Auxiliary Tests

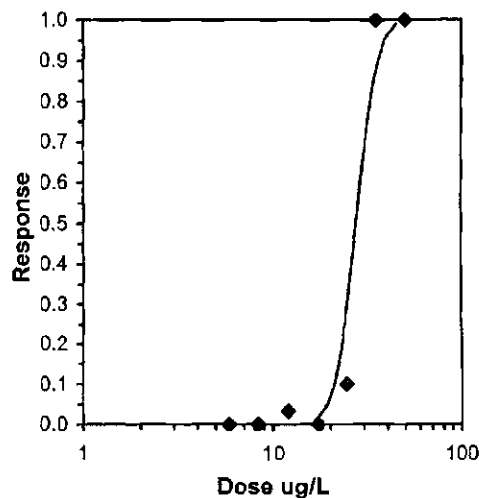
Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.74678	0.91	-0.964
Equality of variance cannot be confirmed			3.13231

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits	Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	10.9385	21.012	-43.075 64.9516	0	722.674	11.0705	6.1E-154	1.43648	0.09142	8
Intercept	-10.713	30.2573	-88.492 67.0659							

Point	Probits	ug/L	95% Fiducial Limits
EC01	2.674	16.742	
EC05	3.355	19.3246	
EC10	3.718	20.8604	
EC15	3.964	21.965	
EC20	4.158	22.8845	
EC25	4.326	23.7039	
EC40	4.747	25.9013	
EC50	5.000	27.3201	
EC60	5.253	28.8166	
EC75	5.674	31.4879	
EC80	5.842	32.6154	
EC85	6.036	33.9807	
EC90	6.282	35.7801	
EC95	6.645	38.6238	
EC99	7.326	44.5817	

Significant heterogeneity detected ($p = 6.14E-154$)



Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 7/7/2010 14:30	Test ID: ESSL1014B	Sample ID: MEASURED CU
End Date: 7/9/2010 14:20	Lab ID: CBI	Sample Type: LAB WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

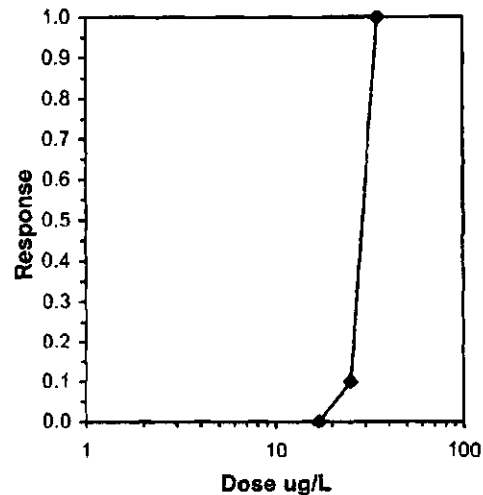
Comments:

Conc-ug/L	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
17	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	0.8000	0.8000	1.0000	0.8000
35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-ug/L	Transform: Arcsin Square Root							Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%	N		
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
17	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
25	0.9000	0.9000	1.2262	1.1071	1.3453	10.637	6	3	30
35	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.76213	0.858	3.3E-15	0.425
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	28.531	27.425	29.683
5.0%	28.892	27.490	30.366
10.0%	29.033	28.379	29.701
20.0%	29.033	28.379	29.701
Auto-0.0%	28.531	27.425	29.683



EFFLUENT, STREAM & DILUTION WATER CHARACTERISTICS
FORM ETF2031WER

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

INITIAL SAMPLE CHARACTERIZATION ¹			
Source	Effluent	Stream	Site = <u>2910m</u>
Tot. Res. Chlorine (mg/l)	<u><QL</u>	<u>N/A</u>	<u>N/A</u>
Hardness (mg/l CaCO ₃)	<u>132</u>		
Alkalinity (mg/l CaCO ₃)	<u>91</u>		
NH ₃ -N (mg/l)	<u><1.0</u>		
Color/Appearance ²	<u>C</u>		
Obvious Odor?	<u>Nb</u>		
Date/Initials	<u>7/5/08</u>		

DILUTION WATER CHARACTERISTICS		
Test	Range-finding	Definitive
Temperature (°C)	<u>25</u>	<u>25</u>
Conductivity (uS/cm)	<u>530</u>	<u>482</u>
D.O. (mg/l)	<u>8.2</u>	<u>8.2</u>
pH (S.U.)	<u>8.26</u>	<u>8.17</u>
Hardness (mg/l CaCO ₃)	<u>154</u>	<u>132</u>
Alkalinity (mg/l CaCO ₃)	<u>92</u>	<u>73</u>
NH ₃ -N (mg/l)	<u>N.D.</u>	<u><1.0</u>
Date/Initials	<u>6/25/08</u>	<u>7/12/08</u>

SAMPLE PREPARATION MEASUREMENTS (100% concentration)			
Test	Range-finding	Definitive	
Source	Site (Mix) = <u>Effluent 100%</u>	Effluent	Stream
Prep Temperature (°C)	<u>25</u>	<u>25</u>	<u>N/A</u>
Conductivity (uS/cm)	<u>625</u>	<u>625</u>	
D.O. (mg/l) After Warming	<u>9.3</u>	<u>9.1</u>	
Aeration Time (min)	<u>1.0</u>	<u>1.0</u>	
Adjusted D.O.	<u>8.2</u>	<u>8.2</u>	
Final pH (S.U.)	<u>8.04</u>	<u>7.84</u>	
Tot. Res. Chlorine (mg/l) ³	<u>N.D.</u>	<u>N.D.</u>	
Sample Filtered (60 um)?	<u>Nb</u>	<u>Nb</u>	
Date/Time	<u>7/5/08</u>	<u>7/7/10</u>	
Initials	<u>bm</u>	<u>CB</u>	

Toxicant: CuCl₂ · 2H₂O

"A" Bottle # 328

Bal. Calib. Chk: 100 mg wt: (60.04 (1.00))

Stock = 67 mg/l 25 ml

Prepared by: PB Date: 6/4/08

RANGE-FINDING TEST:
Highest Concentration = 80 ul in
100 ml Site water

Prepared by: PD Date: 7/5/10

DEFINITIVE TEST:
Highest Concentration = 200 ul in
2000 ml Effluent

Prepared by: PD Date: 7/7/10

¹As total compound. As toxic component = 1 mg/ml

Preparation of test solutions (definitive test)

Test Procedure	Site water	Lab Water
Dilution factor:	<u>0.7x</u>	<u>0.7x</u>
Volume diluted spiked effluent or SFW added to each conc. prep flask:	<u>600 ml</u>	<u>600 ml</u>
Time diluted spiked effluent or SFW added:	<u>1130</u>	<u>1130</u>
Volume stream water added to each flask of spiked effluent:	<u>N/A</u>	
Time stream water added to each flask of spiked effluent:	<u>N/A</u>	

NOTES:

¹Q.L. = Quantification Limit, N.D. = Not Determined/Measured, NA = Not Applicable

²C-Clear, O-Opaque, T-Turbid, S-Solids (SI-Slight, M-Moderate, H-Heavy), Y-Yellow, B-Brown, BI-Black, G-Green

³Total residual chlorine measured after sample prep only if present in initial sample characterization

Peer Rev by AG Date 7/26/10 PROJECT I.D. E55C1014 WER
(First 8 characters of Laboratory Sample ID)

CERIODAPNIA DUBIA WER RANGE-FINDING TEST
FORM ETF1051WER RFT

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

Lab Water RFT					
Nominal Cu ug/l	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Lab Control	C-A	5	5	5	100
	C-B	5	5	5	
1.57	1-A	5	5	5	100
	1-B	5	5	5	
3.13	2-A	5	5	5	100
	2-B	5	5	5	
6.25	3-A	5	5	5	100
	3-B	5	5	5	
12.5	4-A	5	5	5	100
	4-B	5	5	5	
25	5-A	5	3	2	40
	5-B	5	3	2	
50	6-A	5	0	0	0
	6-B	5	0	0	
100	7-A	5	0	0	0
	7-B	5	0	0	
Initials:		CA	CB	CB	
Count Time:		1550	1135	0910	*Test End Time

Site Water RFT					
Nominal Cu ug/l	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Site Control	S-A	5	5	5	100
	S-B	5	5	5	
12.5	1-A	5	5	5	100
	1-B	5	5	5	
25	2-A	5	5	5	100
	2-B	5	5	5	
50	3-A	5	5	5	100
	3-B	5	5	5	
100	4-A	5	5	5	100
	4-B	5	5	5	
200	5-A	5	5	5	90
	5-B	5	4	4	
400	6-A	5	0	0	0
	6-B	5	0	0	
800	7-A	5	0	0	0
	7-B	5	0	0	
Initials:		CB	CB	CB	
Count Time:		1550	1130	0915	*Test End Time

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ✓

Other: _____

Brood Date/time start: 7/4/10 1620

Release: _____

Date /time end: 7/5/10 1020

Acclimation: Water: Mod. hard syn. FW _____

Other (150 mg/L) SFW

Temperature (°C): 25

Feeding: Prior to test: YCT/Selenastrum
During test: Not Fed

Illumination: 16L:8D 10-20 uE/m²/s

Test chamber size: 30 ml

Solution volume: 15 ml _____ ml

Number of replicates/treatment: 2

Initial number of daphnids/replicate: 5

Template number: N/A

Set up: Date (Day 0): 7/5/10

Time water added: 1530

Time daphnids added: 1550

Set up by (initials): PO/CB

End of Test Water Qual.	Lab Water		Site Water	
	Control	Mort	Control	Mort
Temp (°C)	25	25	25	25
pH	8.16	8.12	8.00	7.84
D.O. (mg/l)	7.9	7.6	7.5	7.2
Cond. (uS)	560	600	690	739

*Mort=Lowest concentration with 100% mortality at end of test

Note: SFW hardness is lower (~135 mg/L) for definitive test than RFT. There for will start w/ 50 ppb as highest conc. do, lab water definitive test. P.O. 7/7/10

Peer Rev. by: AG Date: 7/26/10

TEST I.D.(Date) 665L1014 WER-RFT

ESSC1014-A

ESS WO # 92134
ESS PO # 11668

BIOASSAY CHAIN OF CUSTODY

TOXICITY ASSESMENT

WATER EFFECTS RATIO STUDY

Customer Rappahannock WSA VPDES Permit # _____

SAMPLE INFORMATION

Outfall/Location Outfall 001
Collection: Date 7/5/10 Time 4HR Composite 0635 - 1035
Sample volume 5gal Flow rate _____
pH (SU) 7.45 Temp (°C) 28.0°C Chlorine (mg/l) N/A
Dissolved O₂ (mg/l) 6.3 Conductivity (indicate unit) 0.538 MS
Analysis (Date/Time) 7/5/10 @ 1000

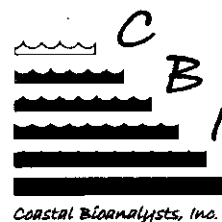
Outfall/Location N/A
Collection: Date _____ Time _____
Sample volume _____ Flow rate _____
pH (SU) _____ Temp (°C) _____ Chlorine (mg/l) _____
Dissolved O₂ (mg/l) _____ Conductivity (indicate unit) _____
Analysis (Date/Time) _____

Sampler's Signature Audie Swan

Samples Relinquished by: Audie Swan Initials AS Date 7/5/10 Time 1130
Samples Received by: Pam Blawie Initials PB Date 7/5/10 Time 1440 1°C
Delivery method to Bioassay Lab: Hand Delivered Coolant used: ICE

Relinquished to Coastal Lab by: E Date _____ Time _____
Received at Coastal Lab by: _____ Date _____ Time _____
Temperature of sample upon receipt @ Coastal Lab: _____

Client: Environmental Systems Service, LTD.
Project ID: ESS1020
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 8/2/10



REPORT: RAPPAHANNOCK WSA - COPPER WER (ROUND 2)

Submitted To: Ms. Angie Woodward Environmental Systems Service, LTD. 218 North Main Street, P.O. Box 520 Culpeper, VA 22701	Prepared By: Coastal Bioanalysts, Inc. 6400 Enterprise Court Gloucester, VA 23061 (804) 694-8285 www.coastalbio.com Contact: Peter F. De Lisle, Technical Director
--	---

METHODS:

Procedures followed the previously submitted and approved study plan. Test methods are summarized below. Details regarding test conduct and data analysis are provided in attached bench sheets and printouts as applicable.

Test Organisms

Six and seven days prior to testing *Ceriodaphnia dubia* cultures were started in hard synthetic freshwater (SFW; 161-200 mg as CaCO_3) using neonate cladocerans. This hardness corresponded to that expected for the effluent. Cultures were fed YCT-*Selenastrum* (@ 3.5×10^7 cells/ml) at a rate of 0.1 ml of each per 15 ml of culture solution. Production and survival of animals raised in the hard water appeared similar to that of standard lab cultures maintained in moderately hard SFW.

Test animals were < 24 h old and selected from females that had produced 3 or more broods with a minimum of 15 offspring produced by the third brood. Animals were not fed during the test but were fed YCT-*Selenastrum* approximately 5 h prior to use in tests.

Test Solutions

Hard SFW was prepared according to the EPA recipe by dissolving ACS reagent-grade (or better) salts in high purity deionized water followed by aeration for at least 24 h. Deionized water was obtained from a Barnstead Nannopure Research Series system. The following treatment train was used for the feed water provided to the Barnstead system: well water > 10 μm particle > softener > 1 μm particle > activated carbon > reverse osmosis > mixed bed anion-cation exchange > 1 μm particle > Barnstead Nannopure.

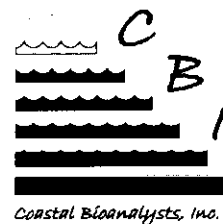
Effluent sample was stored at 3-4°C in the dark until used. Sample was maintained in collapsed Cubitainers with minimal headspace. Effluent was warmed to test temperature prior to use. Minimal (0.5 min) aeration was necessary to reduce oxygen to saturation concentration for range-finding and definitive tests.

Range-finding tests were used to determine appropriate concentrations for use in definitive toxicity tests. For the range-finding tests copper was added directly to site water and then serially diluted to prepare test solutions. "Site water" consisted of 100% undiluted effluent (based on stream and plant permitted design flow). The lab-water test solutions were similarly prepared by serially diluting spiked hard SFW. Copper was added as a 1 $\mu\text{g}/\mu\text{l}$ (1 mg/ml) stock solution prepared by dissolving 67 mg of ACS reagent-grade $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ (99.999+%; Aldrich lot #15726CH) in 25 ml high purity deionized water. The same stock was used for all tests.

For the definitive site water test, copper was added to the effluent (site water) and allowed to equilibrate for 3 h prior to adding animals. A 2 L volume of the highest concentration of spiked effluent was prepared by adding 1200 μl of copper stock solution. Thus the final concentration was 600 $\mu\text{g}/\text{l}$ (assuming no background Cu). Serial dilutions (0.7X) of spiked site water were prepared by pouring off an 600 ml aliquot of the highest concentration and bringing back to volume with un-spiked effluent. The 600 ml aliquots were added to labeled 1 L plastic beakers. The



Client: Environmental Systems Service, LTD.
Project ID: ESSL1020
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 8/2/10



procedure was repeated to prepare seven beakers of solution of decreasing concentration. A control beaker received 600 ml of un-spiked effluent. The beakers were then allowed to stand for 3 h before being used in tests.

For the definitive lab water test 2 L of the highest concentration of hard SFW was prepared by spiking with 100 μ l of copper stock solution (final concentration 50 μ g/l). Serial dilutions (0.7X) of the spiked lab water were prepared as described above except using hard SFW as the diluent. The lab water solutions were then allowed to stand for 3 h before being used in tests.

Chemical Analyses

Samples of hard SFW and effluent were collected at the beginning of the test for TOC, TSS, and DOC analyses. Samples were stored at 3-4° C in the dark until shipped later with copper samples for analyses. Samples (approx. 200 ml) were collected from each treatment at the beginning of the test for total Cu. Total Cu samples were poured directly into sample containers. Copper samples from both the lab and site tests, as well as TOC and DOC samples, were sent to Reed and Associates (Newport News, VA) for analysis. TSS samples were sent to ESS for analysis. All sampling supplies were provided by the chemistry labs.

Measurements of dissolved oxygen, pH, temperature, conductivity, total residual chlorine, hardness, alkalinity and ammonia were performed using EPA methods. Instruments and titrations were calibrated using standards and/or titrants traceable to NIST where applicable.

Toxicity Tests

Toxicity test methods followed EPA Method 2002.0 (Acute *Ceriodaphnia dubia*). Toxicity tests were conducted using 1 oz. plastic shot glasses rather than borosilicate glass to decrease adsorption of Cu to vessel walls. Six replicates of 5 animals and 25 ml of solution were tested. In addition, two dummy replicates (rather than one) were included for water quality measurements (D.O., pH, temperature, conductivity) at T=24 h and T=48 h. These "chemistry controls" were loaded with test animals in the same manner as actual test chambers. Test chambers were arranged in a randomized block design prior to addition of animals and throughout the test.

Calculations

Following the EPA WER guidelines (EPA, 1994) four significant figures were retained in all calculations and endpoints to prevent round-off error. EC50s were calculated using the ToxCalc (version 5.0.23) software.

EC50s for lab and site water tests were calculated using nominal and measured total Cu. Because the probit method could not be used for both sets of tests, the Trimmed Spearman-Kärber method was used for all computations of measured Cu toxicity.

EC50 values were normalized to a standard (test) hardness of 200 mg/l based on the WER guidance formula (see EPA 2001):

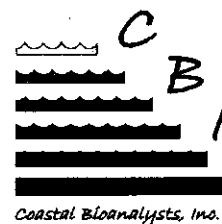
$$EC50_{\text{Standard Hardness}} = EC50_{\text{Test Hardness}} \times (\text{Standard Hardness/Test Hardness})^{0.9422}$$

For WER calculations, the hardness-adjusted Species Mean Acute Value (SMAV) was based on the value calculated at the criteria reference hardness (CRH, 100 mg/l) and published in the WER guidance document (24.0 μ g/l total; EPA2001). The following formula (from EPA 2001) was used to normalize the SMAV value to the test standard hardness of 200 mg/l:

$$SMAV_{\text{Test Hardness}} = SMAV_{\text{CRH (100)}} \times (\text{Test Hardness}/100 \text{ mg/l})^{0.9422}$$



Client: Environmental Systems Service, LTD.
 Project ID: ESSL1020
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 8/2/10



RESULTS:

Table 1. EC50 values (Total Cu)

Test Matrix	48-h EC50 (µg/l)	95% C.L.	Test Hardness (mg/l CaCO ₃)	Normalized* 48-h EC50 (µg/l)
Lab Water:	23.12	21.62-24.73	198	23.34
Site Water:	278.0	264.4-292.2	200	278.0

*Normalized to a standard hardness of 132 mg/l (as CaCO₃).

Table 2. Calculated WER values.

Chemical Basis	WER Denominator Basis*	Normalized Site Water EC50 (µg/l)	Normalized Lab or SMAV EC50 (µg/l)	WER
Total Copper	Lab Water	278.0	23.34	11.91
	EPA 2001	278.0	46.11	6.029

NOTE: EPA (2001) states "If the hardness-normalized EC50 in laboratory water is less than the documented SMAV for the species (i.e. EPA 2001 value), then use the SMAV in place of the laboratory water EC50 in the dominator of the WER"

Table 3. Biological and Chemical Summary Data - Lab Water Test

Total Cu (µg/l)		Survival (%)	
Nominal	Measured	24-h	48-h
0*	<2	100	100
5.88	ND	100	100
8.40	ND	100	100
12.0	13	100	100
17.2	18	100	93.3
24.5	25	100	26.7
35.0	34	100	6.67
50.0	50	100	0

*Lab Control (hard synthetic freshwater)



Client: Environmental Systems Service, LTD.
 Project ID: ESSL1020
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 8/2/10

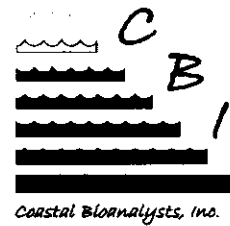


Table 4. Biological and Chemical Summary Data – Site Water Toxicity Tests

Total Cu (µg/l)			Survival (%)	
Nominal	Nominal + Background	Measured	24-h	48-h
0*	17	17	100	100
70.6	87.6	ND	100	100
101	118	ND	100	100
144	161	ND	100	100
206	223	220	100	100
294	311	302	93.3	23.3
420	437	632**	0	0
600	617	597	0	0

*Site Control (100% un-spiked effluent)

**Because test treatments were prepared as serial dilutions of the highest concentration (600 µg/l), this value is not possible as all lower dilutions would also be much greater than the nominal values. The value appears to be due to an analytical error or contaminated sample bottle. The nominal value of 420 µg/l was used for this treatment to calculate a conservative (i.e. lower) site LC50.

Table 5. Test Set-up Information

Test Matrix	Definitive Test Start Date/Time End Date/Time	Organism Source	Brood Release Date/Time	Acclimation Temp.	Acclimation Water	Test Aerated?
Lab Water	8/4/10 1530	CBI	8/3/10 1700	25° C	Hard SFW	No
	8/6/10 1550	Stock	8/4/10 1020			
Site Water	8/4/10 1545	CBI	8/3/10 1700	25° C	Hard SFW	No
	8/6/10 1600	Stock	8/4/10 1020			

Table 6. Lab and Effluent Water Quality Data

Water Quality Parameter (Units)	Lab Water	Effluent
Arrival Temperature (°C)	N/A	4
Use Temperature (°C)	25	25
Conductivity (µS/cm)	695	818
pH (S.U.)	8.34	7.73
Dissolved Oxygen (mg/l)	8.2	8.2
Total Hardness (mg/l as CaCO ₃)	198	200
Alkalinity (mg/l as CaCO ₃)	129	103
DOC (mg/l)	0.8	6.7
TOC (mg/l)	0.8	6.7
TSS (mg/l)	<1.0	3.4
Total Residual Chlorine (mg/l)	N/A	<Q.L.
Ammonia (mg/l NH ₃ -N)	<1.0	<1.0



Client: Environmental Systems Service, LTD.
 Project ID: ESS1020
 Client Sample ID: Rappahannock WSA Outfall 001
 Permit No: not given
 Sample Period: 8/2/10

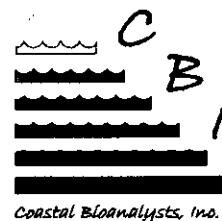


Table 7. Sample Aging/Use/Pretreatment

CBI Sample I.D.	Collection Date/Time	Date(s)/Time(s) Used in Range Tests	Date(s)/Time(s) Used in Definitive Tests	Sample Adjustments
ESS1020-A	8/2/10 0710-1110	8/2/10 1620	8/4/10 1530 (lab), 1545 (site)	Aerated 0-0.5 min

Table 8. Lab Water Test - Water Quality (Mean/Std. Dev.)

Nominal Cu (µg/l):	Cont.	5.88	8.40	12.0	17.2	24.5	35.0	50.0
Temp. (°C)	25 0.6	25 0.6	25 0.6	25 0.6	25 0.6	25 0.6	25 0.6	25 0.6
D.O. (mg/l)	8.1 0.1	8.1 0.1	8.1 0.1	8.1 0.1	8.1 0.1	8.1 0.1	8.1 0.1	8.1 0.1
PH (S.U.)	8.39 0.07	8.39 0.07	8.39 0.07	8.38 0.07	8.38 0.07	8.38 0.07	8.39 0.07	8.39 0.07

Table 9. Site Water Test - Water Quality (Mean/Std. Dev.)

Nominal Cu (µg/l):	Cont.	70.6	101	144	206	294	420	600
Temp. (°C)	25 0	25 0	25 0	25 0	25 0	25 0	25 0	25 0
D.O. (mg/l)	8.1 0.2	8.1 0.2	8.1 0.2	8.1 0.1	8.1 0.1	8.2 0.1	8.2 0	8.2 0
PH (S.U.)	8.07 0.18	8.11 0.16	8.13 0.16	8.13 0.16	8.15 0.17	8.14 0.19	8.10 0.25	8.09 0.26

Table 10. Reference Toxicant Test Data
 (Reference Toxicant: KCl; Units: mg/l; CBI Stock Cultures)

Species-Method (Ref. Test Date)	Data Source	% Control Survival	48-h EC50	95% C.L./A.L. For EC50	RTT in Control?
<i>C. dubia</i> 2002.0 (8/1/10-8/3/10)	RTT	100	583	532-638	Yes
	CC	100	586	501-670	

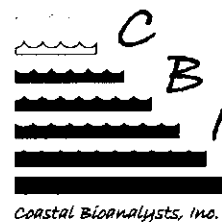
Note: RTT = Reference Toxicant Test, CC = Control Chart.

DISCUSSION:

A WER value of 6.029 is obtained based on the ratio of the site EC50 to the hardness-adjusted SMAV. Based on the geometric mean of the first WER study (8.042) and the present study (6.029) a final WER value for total copper of 6.963 is obtained.



Client: Environmental Systems Service, LTD.
Project ID: ESSL1020
Client Sample ID: Rappahannock WSA Outfall 001
Permit No: not given
Sample Period: 8/2/10



LITERATURE CITED:

EPA 1994. *Interim Guidance on Determination and Use of Water-effects Ratios for Metals*. February 1994. EPA-823-B-94-001.

EPA 2001. Streamlined Water-Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005. United States Environmental Protection Agency, Office of Water, March 2001.

GLOSSARY OF TERMS AND ABBREVIATIONS:

A.L. (Acceptance Limits): The results of a given reference toxicant test are compared to the control chart mean value ± 2 standard deviations. These limits approximate the 95% probability limits for the "true" reference toxicant value.

C.L. (Confidence Limits): These are the probability limits, based on the data set and statistical model employed, that the "true value" lies within the limits specified. Typically limits are based on 95% or 99% probabilities.

Control chart: A cumulative summary chart of results from QC tests with reference toxicants. The results of a given reference toxicant test are compared to the control chart mean value and 95% Acceptance Limits (A.L.) (mean ± 2 standard deviations).

EC50/LC50: The concentration of sample or chemical, calculated from the data set using statistical models, causing a 50% reduction in test organism survival or mobilization. The lower the EC50/ LC50, the more toxic the chemical or sample. Units are same as test concentration units. Note: The LC50 or EC50 value must always be associated with the duration of exposure.

N/A: Not applicable. **N/D:** Not determined or measured.


Q.L.: Quantitation Limit. Level, concentration, or quantity of a target variable (analyte) that can be reported at a specified degree of confidence.

Species Mean Acute Value (SMAV): Mean value of hardness-normalized EC50 values. Used in the criteria document for calculation of water quality criteria.

Water-Effect Ratio (WER): A criteria adjustment factor accounting for the effect of site-specific water characteristics on pollutant bioavailability and toxicity to aquatic life (from EPA 2001).

The results of analysis contained within this report relate only to the sample as received in the laboratory. This report shall not be reproduced except in full without written approval from the laboratory. Unless noted below, these test results meet all requirements of NELAP.

APPROVED:


Peter F. De Lisle, Ph.D.
Technical Director

11/9/10
Date

Deviations from, additions to, or exclusions from the test method, non-standard conditions or data qualifiers and, as appropriate, a statement of compliance/non-compliance: **NONE**



CERIODAPHNIA DUBIA STATIC ACUTE TEST - WER
FORM ETF1051WER

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

Parameter	Treatment I.D.	Day 0	Day 1	Day 2
Temp. (°C)	C	25	24	25
	1	25	24	25
	2	25	24	25
	3	25	24	25
	4	25	24	25
	5	25	24	25
	6	25	24	25
	7	25	24	25
pH (S.U.)	C	8.31	8.45	8.40
	1	8.31	8.45	8.40
	2	8.31	8.45	8.40
	3	8.31	8.45	8.38
	4	8.31	8.45	8.38
	5	8.31	8.45	8.38
	6	8.31	8.45	8.41
	7	8.31	8.45	8.42
D.O. (mg/l)	C	8.2	8.2	8.0
	1	8.2	8.2	8.0
	2	8.2	8.1	8.0
	3	8.2	8.1	8.1
	4	8.2	8.1	8.1
	5	8.2	8.1	8.0
	6	8.2	8.1	8.0
	7	8.2	8.1	8.0
Conduct. (Us/cm)	C	691		696
	1	696		
	2	698		
	3	698		
	4	697		
	5	701		
	6	697		
	7	697		703
Replicate Meas.:		S	S	S
Initials:		GA	AG	LA
TRC (mg/l) in highest conc. at end of test:				NA

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ✓

Other: _____

Brood Date/time start: 8/3/10 1200

Release: Date/time end: 8/4/10 1020

Acclimation: Water: Mod. hard syn. FW

Other: 161 - 200 mg/L SW

Temperature (°C): 25

Feeding: Prior to test: YCT/Selenastrum
During test: Not Fed

Illumination: 16L:8D 10-20 uE/m²/s

Test chamber size: ✓ 30 ml

Solution volume: ✓ 15 ml _____ ml

Number of replicates/treatment: 6

Initial number of daphnids/replicate: 5

Template number: NA

Set up: Date (Day 0): 8/4/10

Time water added: 1450 W

Time daphnids added: 1530

Set up by (initials): PP/LB

① mix beaker → cups

Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival	Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Control	C-a	5	5	5	100	17.2	4-a	5	5	4	93
	C-b	5	5	5			4-b	5	5	4	
	C-c	5	5	5			4-c	5	5	5	
	C-d	5	5	5			4-d	5	5	5	
	C-e	5	5	5			4-e	5	5	5	
	C-f	5	5	5			4-f	5	5	5	
5.88	1-a	5	5	5	100	24.5	5-a	5	5	1	27
	1-b	5	5	5			5-b	5	5	1	
	1-c	5	5	5			5-c	5	5	2	
	1-d	5	5	5			5-d	5	5	0	
	1-e	5	5	5			5-e	5	5	3	
	1-f	5	5	5			5-f	5	5	1	
8.47	2-a	5	5	5	100	35.0	6-a	5	5	2	7
	2-b	5	5	5			6-b	5	5	0	
	2-c	5	5	5			6-c	5	5	0	
	2-d	5	5	5			6-d	5	5	0	
	2-e	5	5	5			6-e	5	5	0	
	2-f	5	5	5			6-f	5	5	0	
12.0	3-a	5	5	5	100	50.0	7-a	5	5	0	0
	3-b	5	5	5			7-b	5	5	0	
	3-c	5	5	5			7-c	5	5	0	
	3-d	5	5	5			7-d	5	5	0	
	3-e	5	5	5			7-e	5	5	0	
	3-f	5	5	5			7-f	5	5	0	
						Initials:	CB	AG	CB		
						Count Time:	1530	1020	1550	Test end time	

Peer Rev by: PD Date: 8/10/10

0.7x dilution factor (2L highest conc; pour 40 600 ml each dilution)

Highest conc = 100 µl Cu Stock in 2L hard SW

Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 8/4/2010 15:30	Test ID: ESSL1020A	Sample ID: RAPPAHANNOCK WSA 001
End Date: 8/6/2010 15:50	Lab ID: CBI	Sample Type: MEASURED CU-LAB WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

Comments:

Conc-ppb	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
18	0.8000	0.8000	1.0000	1.0000	1.0000	1.0000
25	0.2000	0.2000	0.4000	0.0000	0.6000	0.2000
34	0.4000	0.0000	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-ppb	Transform: Arcsin Square Root							Number Resp	Total Number
	Mean	N-Mean	Mean	Min	Max	CV%	N		
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
13	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
18	0.9333	0.9333	1.2659	1.1071	1.3453	9.714	6	2	30
25	0.2667	0.2667	0.5312	0.2255	0.8861	42.649	6	22	30
34	0.0667	0.0667	0.3020	0.2255	0.6847	62.066	6	28	30
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

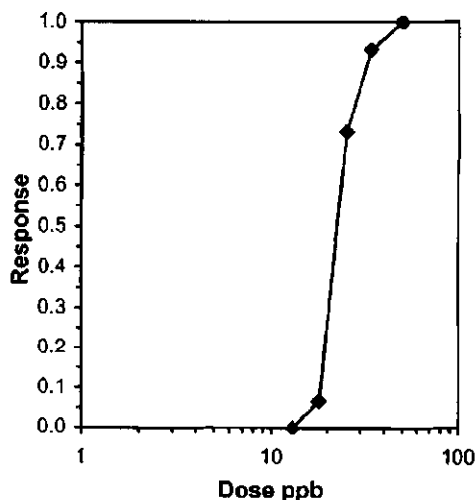
Auxiliary Tests

Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	Statistic 0.85411	Critical 0.9	Skew 1.06152	Kurt 3.33396
---	-------------------	--------------	--------------	--------------

Equality of variance cannot be confirmed

Trimmed Spearman-Kärber

Trim Level	EC50	95% CL	
0.0%	23.121	21.617	24.729
5.0%	22.900	21.429	24.471
10.0%	22.693	21.228	24.258
20.0%	22.371	20.841	24.013
Auto-0.0%	23.121	21.617	24.729



Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 8/4/2010 15:30	Test ID: ESSL1020L	Sample ID: RAPPAHANNOCK WSA 001
End Date: 8/6/2010 15:50	Lab ID: CBI	Sample Type: LAB WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

Comments:

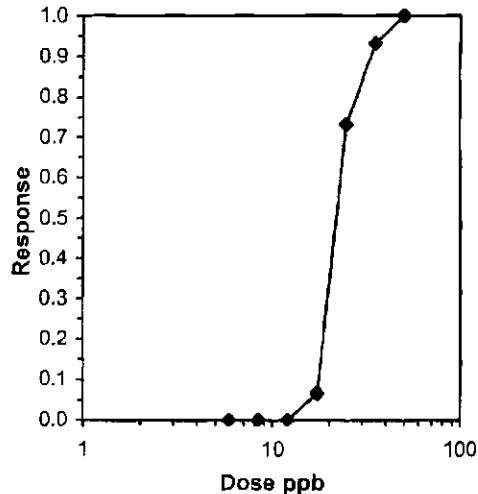
Conc-ppb	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5.88	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8.4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
17.2	0.8000	0.8000	1.0000	1.0000	1.0000	1.0000
24.5	0.2000	0.2000	0.4000	0.0000	0.6000	0.2000
35	0.4000	0.0000	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
5.88	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
8.4	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
12	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
17.2	0.9333	0.9333	1.2659	1.1071	1.3453	9.714	6	2	30
24.5	0.2667	0.2667	0.5312	0.2255	0.8861	42.649	6	22	30
35	0.0667	0.0667	0.3020	0.2255	0.6847	62.066	6	28	30
50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.77486	0.922	1.23693	5.64348
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber

Trim Level	EC50	95% CL	
0.0%	22.567	20.968	24.288
5.0%	22.361	20.776	24.067
10.0%	22.123	20.536	23.832
20.0%	21.747	20.113	23.515
Auto-0.0%	22.567	20.968	24.288



Parameter	Treatment I.D.	Day 0	Day 1	Day 2
Temp. (°C)	C	25	25	25
	1	25	25	25
	2	25	25	25
	3	25	25	25
	4	25	25	25
	5	25	25	25
	6	25	25	—
	7	25	25	—
pH (S.U.)	C	7.82	8.20	8.19
	1	7.93	8.22	8.18
	2	7.95	8.24	8.21
	3	7.95	8.24	8.21
	4	7.95	8.25	8.24
	5	7.92	8.25	8.24
	6	7.92	8.27	—
	7	7.90	8.27	—
D.O. (mg/l)	C	8.2	8.1	7.9
	1	8.2	8.1	7.9
	2	8.2	8.2	7.9
	3	8.2	8.2	8.0
	4	8.2	8.2	8.0
	5	8.2	8.2	8.1
	6	8.2	8.2	—
	7	8.2	8.2	—
Conduct. (Us/cm)	C	824		835
	1	831		
	2	832		
	3	833		
	4	835		
	5	836		859
	6	835		—
	7	835		—
Replicate Meas.:		S	S	S
Initials:		CM	AG	CB
TRC (mg/l) in highest conc. at end of test:				NA

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ☒

Other: _____

Brood Date/time start: 8/3/10 1700

Release: _____

Date /time end: 8/4/10 1000

Acclimation: Water: Mod. hard syn. FW _____

Other: 161 -
200 mg/l SW

Temperature (°C): 25

Feeding: Prior to test: YCT/*Selenastrum*

During test: Not Fed

Illumination: 16L:8D 10-20 uE/m²/s

Test chamber size: ☒ 30 ml

Solution volume: ☒ 15 ml _____ ml

Number of replicates/treatment: 6

Initial number of daphnids/replicate: 5

Template number: NA

Set up: Date (Day 0): 8/4/10

Time water added: 1455 W

Time daphnids added: 1545

Set up by (Initials): PDB

① Mixing beakers → cups

Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival	Nominal Cu (µg/l)	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Control	C-a	5	5	5	100	206	4-a	5	5	5	100
	C-b	5	5	5			4-b	5	5	5	
	C-c	5	5	5			4-c	5	5	5	
	C-d	5	5	5			4-d	5	5	5	
	C-e	5	5	5			4-e	5	5	5	
	C-f	5	5	5			4-f	5	5	5	
70.6	1-a	5	5	5	100	294	5-a	5	5	2	23
	1-b	5	5	5			5-b	5	3	0	
	1-c	5	5	5			5-c	5	5	1	
	1-d	5	5	5			5-d	5	5	1	
	1-e	5	5	5			5-e	5	5	2	
	1-f	5	5	5			5-f	5	5	1	
101	2-a	5	5	5	100	420	6-a	5	0	0	0
	2-b	5	5	5			6-b	5	0	0	
	2-c	5	5	5			6-c	5	0	0	
	2-d	5	5	5			6-d	5	0	0	
	2-e	5	5	5			6-e	5	0	0	
	2-f	5	5	5			6-f	5	0	0	
144	3-a	5	5	5	100	600	7-a	5	0	0	0
	3-b	5	5	5			7-b	5	0	0	
	3-c	5	5	5			7-c	5	0	0	
	3-d	5	5	5			7-d	5	0	0	
	3-e	5	5	5			7-e	5	0	0	
	3-f	5	5	5			7-f	5	0	0	
						Initials:	GB	AG	CB		
						Count Time:	1545	1030	1400	*Test end time	

Peer Rev by: pb Date: 8/10/10

0.7 x dilution factor (2 L highest concentration; pour off 600 ml each dilution)

Highest conc = 1200 µl Cu stock in 2 L effluent

Acute Ceriodaphnia Test-48 Hr Survival

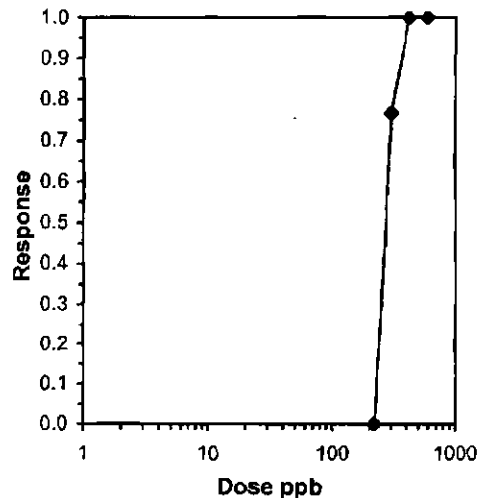
Start Date: 8/4/2010 15:45	Test ID: ESSL1020B	Sample ID: RAPPAHANNOCK WSA 001
End Date: 8/6/2010 16:00	Lab ID: CBI	Sample Type: MEASURED CU-SITE WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia
Comments:		

Conc-ppb	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
220	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
302	0.4000	0.0000	0.2000	0.2000	0.4000	0.2000
420	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
597	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Conc-ppb	Mean	N-Mean	Transform: Arcsin Square Root					Number Resp	Total Number
			Mean	Min	Max	CV%	N		
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
220	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
302	0.2333	0.2333	0.4976	0.2255	0.6847	34.515	6	23	30
420	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30
597	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.65927	0.858	-0.5877	5.22416
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	277.96	264.42	292.19
5.0%	275.59	261.03	290.97
10.0%	273.51	258.34	289.58
20.0%	270.74	256.30	285.99
Auto-0.0%	277.96	264.42	292.19



Acute Ceriodaphnia Test-48 Hr Survival

Start Date: 8/4/2010 15:45	Test ID: ESSL1020S	Sample ID: RAPPAHANNOCK WSA 001
End Date: 8/6/2010 16:00	Lab ID: CBI	Sample Type: SITE WATER
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species: CD-Ceriodaphnia dubia

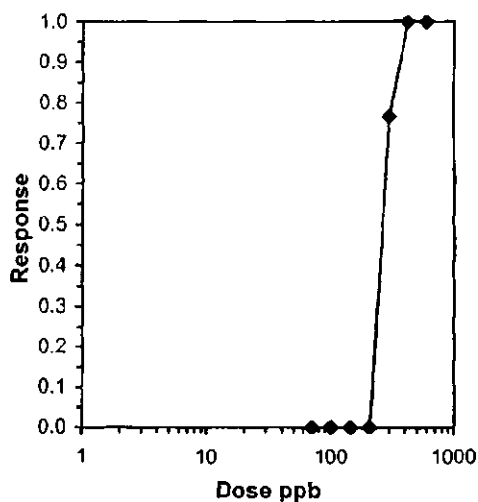
Comments:

Conc-ppb	1	2	3	4	5	6
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
70.6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
101	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
144	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
206	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
294	0.4000	0.0000	0.2000	0.2000	0.4000	0.2000
420	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Transform: Arcsin Square Root								Number	Total
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
CONTROL	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
70.6	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
101	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
144	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
206	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	6	0	30
294	0.2333	0.2333	0.4976	0.2255	0.6847	34.515	6	23	30
420	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30
600	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	6	30	30

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution ($p \leq 0.01$)	0.47395	0.912	-0.7937	11.8813
Equality of variance cannot be confirmed				

Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%	267.42	253.11	282.55
5.0%	265.00	249.61	281.35
10.0%	262.88	246.82	279.98
20.0%	260.04	244.64	276.42
Auto-0.0%	267.42	253.11	282.55



CERIODAPNIA DUBIA WER RANGE-FINDING TEST
FORM ETF1051WER RFT

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

Lab Water RFT					
Nominal Cu ug/l	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Lab Control	C-A	5	5	5	100
	C-B	5	5	5	
1.57	1-A	5	5	5	100
	1-B	5	5	5	
3.13	2-A	5	5	5	100
	2-B	5	5	5	
6.25	3-A	5	5	5	100
	3-B	5	5	5	
12.5	4-A	5	5	5	90
	4-B	5	5	4	
25	5-A	5	1	0	10
	5-B	5	2	1	
50	6-A	5	0	0	0
	6-B	5	0	0	
100	7-A	5	0	0	0
	7-B	5	0	0	
Initials:		CB	CA	CB	
Count Time:		1420	0925	0910	*Test End Time

Site Water RFT					
Nominal Cu ug/l	I.D.	Day 0 Live	Day 1 Live	Day 2 Live	Final % Survival
Site Control	S-A	5	5	5	100
	S-B	5	5	5	
12.5	1-A	5	5	5	100
	1-B	5	5	5	
25	2-A	5	5	5	100
	2-B	5	5	5	
50	3-A	5	5	5	100
	3-B	5	5	5	
100	4-A	5	5	5	100
	4-B	5	5	5	
200	5-A	5	2	2	40
	5-B	5	3	2	
400	6-A	5	0	0	0
	6-B	5	0	0	
800	7-A	5	0	0	0
	7-B	5	0	0	
Initials:		CB	CB	CB	
Count Time:		1425	0914	0915	*Test End Time

Species: *Ceriodaphnia dubia*

Source: CBI stock cultures ✓

Other: _____

Brood Date/time start: 8/1/10 1630

Release: _____

Date /time end: 8/2/10 1030

Acclimation: Water: Mod. hard syn. FW ✓

Other: _____

Temperature (°C): 25

Feeding: Prior to test: YCT/Selenastrum

During test: Not Fed

Illumination: 16L:8D 10-20 uE/m²/s

Test chamber size: ✓ 30 ml

Solution volume: ✓ 15 ml _____ ml

Number of replicates/treatment: 2

Initial number of daphnids/replicate: 5

Template number: N/A

Set up: Date (Day 0): 8/2/10

Time water added: 1405

Time daphnids added: 1420

Set up by (initials): CA

End of Test Water Qual.	Lab Water		Site Water	
	Control	Mort	Control	Mort
Temp (°C)	25	25	25	25
pH	8.26	8.22	8.14	8.12
D.O. (mg/l)	8.0	8.0	7.9	8.0
Cond. (uS)	558	596	813	826

*Mort=Lowest concentration with 100% mortality at end of test

① CB 8/4/10

Peer Rev. by: PB Date: 8/10/10

TEST I.D.(Date) E55L1020 WER-RFT

EFFLUENT, STREAM & DILUTION WATER CHARACTERISTICS
FORM ETF2031WER

COASTAL BIOANALYSTS, INC
EFFECTIVE DATE: 2/9/09

INITIAL SAMPLE CHARACTERIZATION ¹			
Source	Effluent	Stream	Site
Tot. Res. Chlorine (mg/l)	<Q.L.	NA	NA
Hardness (mg/l CaCO ₃)	200		
Alkalinity (mg/l CaCO ₃)	103		
NH ₃ -N (mg/l)	<1.0		
Color/Appearance ²	CY		
Obvious Odor?	NO		
Date/Initials	8/2/14/0		

DILUTION WATER CHARACTERISTICS		
Test	Range-finding	Definitive
Temperature (°C)	25	25
Conductivity (uS/cm)	528	695
D.O. (mg/l)	8.2	8.2
pH (S.U.)	8.21	8.34
Hardness (mg/l CaCO ₃)	150	198
Alkalinity (mg/l CaCO ₃)	94	129
NH ₃ -N (mg/l)	<1.0	<1.0
Date/Initials	8/2/09	8/4/09

SAMPLE PREPARATION MEASUREMENTS (100% concentration)			
Test	Range-finding	Definitive	
Source	Site (Mix)	Effluent	Stream
Prep Temperature (°C)	25	25	NA
Conductivity (uS/cm)	795	818	
D.O. (mg/l) After Warming	8.0	8.5	
Aeration Time (min)	-	0.5	
Adjusted D.O.	-	8.2	
Final pH (S.U.)	7.64	7.73	
Tot. Res. Chlorine (mg/l) ³	N.D.	N.D.	
Sample Filtered (60 um)?	NA	NA	
Date/Time	8/2/15/0	8/4/10/5	
Initials	LB	LA	

Toxicant: CuCl₂ · 2H₂O

"A" Bottle # 328

Bal. Calib. Chk: 100 mg wt: 100.04

Stock = 67 mg/ 25 ml

Prepared by: PA Date: 4/4/04

RANGE-FINDING TEST:
Highest Concentration = 80 ul in

100 ml Site water

Prepared by: LB Date: 8/2/10

DEFINITIVE TEST:
Highest Concentration = 1200 ul in

2000 ml Effluent

Prepared by: LA Date: 8/4/10

¹As total compound. As toxic component = 1 mg/l

Preparation of test solutions (definitive test)

Test Procedure	Site water	Lab Water
Dilution factor:	<u>0.7X</u>	<u>0.7X</u>
Volume diluted spiked effluent or SFW added to each conc. prep flask:	<u>600 ml</u>	<u>600 ml</u>
Time diluted spiked effluent or SFW added:	<u>1140</u>	<u>1120</u>
Volume stream water added to each flask of spiked effluent:	<u>NA</u>	
Time stream water added to each flask of spiked effluent:	<u>NA</u>	

NOTES:

¹Q.L. = Quantification Limit, N.D. = Not Determined/Measured, NA = Not Applicable

²C-Clear, O-Opaque, T-Turbid, S-Solids (Sl-Slight, M-Moderate, H-Heavy), Y-Yellow, B-Brown, Bl-Black, G-Green

³Total residual chlorine measured after sample prep only if present in initial sample characterization

Peer Rev by LB Date 8/10/10 PROJECT I.D. E551020 WER
(First 8 characters of Laboratory Sample ID)

ESS WQ # _____

ESS PO # 12374**BIOASSAY CHAIN OF CUSTODY**Customer Rappahannock WWS VPDES Permit # _____Outfall/Location Outfall 001**SAMPLE INFORMATION****GRAB**

Collection: Date _____ Time _____
 Sample volume _____ Flow rate _____

Effluent: pH (SU) _____ Temp (°C) _____ Chlorine (mg/l) _____
 Dissolved O₂ (mg/l) _____ Conductivity (indicate unit) _____
 Analysis (Date/Time) _____

COMPOSITE

(4HC) 8/21/0 0710 8/21/0
 Collection: From (Date/Time): 7/21/0 @ 0710 To (Date/Time): 7/21/0 @ 1110
 # of samples 5 Volume 5 gal Flow rate ≈ 4 gpm
 Auto-sampler temperature (°C) N/A

Effluent: pH (SU) 7.248 Temp (°C) 25.1 Chlorine (mg/l) N/A
 Dissolved O₂ (mg/l) 0.86 8/21/0
 Analysis (Date/Time) 1010 @ 8/21/0

Sampler's Signature [Signature]

Received at ESS Lab by: P. Blawie Date 8/21/0 Time 1440
 Delivery method to Bioassay Lab: _____ Coolant used: _____

Received at Coastal Lab by: P. Blawie Date 8/21/0 Time 1440
 Temperature of sample upon receipt @ Coastal Lab: 4

_____	Chronic	<i>Ceriodaphnia dubia</i>
_____	Chronic	<i>Pimephales promelas</i>
_____	Acute	<i>Ceriodaphnia dubia</i>
_____	Acute	<i>Pimephales promelas</i>

① per phone conversation with Andrea 8/21/0 1500 CB

5

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: LC
SAMPLE NO: 10-11356

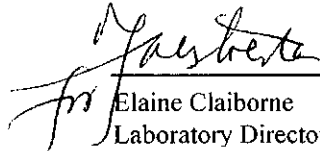
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	< 0.002	mg/L	EFA 7/14/10	1211

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10

RECEIVED JUL 21 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L4
SAMPLE NO: 10-11357

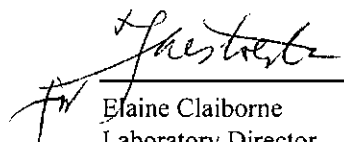
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.017	mg/L	EFA 7/14/10	1217

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L5
SAMPLE NO: 10-11358

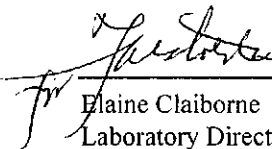
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.025	mg/L	EFA 7/14/10	1219

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:
Date: 7/7/10 Time: 1430
COMPOSITE COLLECTION:
Start Date: Time:
End Date: Time:



PICK UP BY: UPS
SAMPLE RECEIPT:
Date: 7/8/10 Time: 0940
NUMBER OF CONTAINERS: 1
SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)

SAMPLE ID: L6
SAMPLE NO: 10-11359

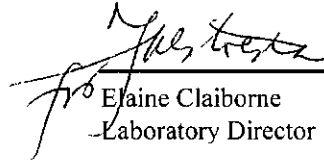
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.035	mg/L	EFA 7/14/10	1221

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10

RECEIVED JUL 21 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

Special Notes:

RE: RAPPAHANNOCK WATER AND

SEWER AUTHORITY - WER STUDY

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SC
SAMPLE NO: 10-11360

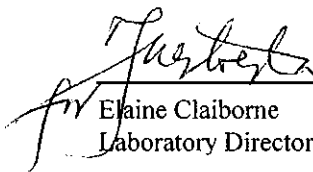
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.018	mg/L	EFA 7/14/10	1224

NOTES:

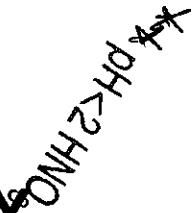
JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10

* additional HNO_3 added to 10.11356-11360 upon arrival



ANALYSES REQUESTED

[illegible]

PO #11668

PO # 11668			Composite				Grab			TOC	DOD	CU
JRA ID #	Sample Type*	Sample Location	Start Date	Start Time	End Date	End Time	Date	Time	Total # of cont.			
10 11356	WW	Lc					7/1/10	1430	1			
		L1										
		L2										
		L3										
11357		L4										
11358		L5										
11359		L6										
		L7										
11360		S1										

Sampled By: _____ Date/Time: _____
 Relinquished By: _____ Date/Time: _____
 Received By: _____ Date/Time: _____
 Relinquished By: _____ Date/Time: 7-8-10 0940
 Received By: _____ Date/Time: 7-8-10 0940

1 = 6°C 6 = $\text{Na}_2\text{S}_2\text{O}_3 + \text{HCl}$ 10 = Ascorbic Acid + HCl
 2 = HNO_3 7 = $\text{NaOH} + \text{ZnOAc}$ 11 = HCl
 3 = H_2SO_4 8 = $\text{H}_2\text{SO}_4 + \text{FAS}$ 12 = Zinc Acetate + NaOH
 4 = NaOH 9 = NH_4Cl 13 = $\text{Na}_2\text{SO}_3 + \text{HCl}$
 5 = $\text{Na}_2\text{S}_2\text{O}_3$ 14 = $\text{Na}_2\text{SO}_3 + \text{H}_2\text{SO}_4$

VOA Chlorine Check: POS___NEG___ By:_____
Dechlorinated: Yes

CN Interference Check:

	Positive	Negative
Sulfide:	<u> </u>	<u> </u>
Oxidizing Agent:	<u> </u>	<u> </u>

PAGE 1 of 2

NOTE: PLEASE DO NOT
ANALYZE CV SAMPLES UNTIL
NOTIFIED RE: WHICH SAMPLES TO RUN

Arrival Temp: 5.8 °C

JAMES R. REED and ASSOCIATES (757) 873-4703; FAX (757) 873-1498

770 Pilot House Drive, Newport News, VA 23606

THE
NEW
YORK

LIBRARY OF THE
CITY OF NEW YORK
HISTORICAL SOCIETY

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S3
SAMPLE NO: 10-11361


Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.168	mg/L	EFA 7/14/10	1232

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director

Date: 16-Jul-10

RECEIVED JUL 21 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S4
SAMPLE NO: 10-11362

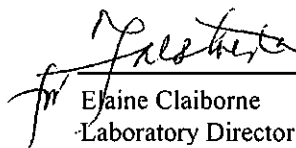
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.227	mg/L	EFA 7/14/10	1234

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director

Date: 16-Jul-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 7/7/10 Time: 1430

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S5
SAMPLE NO: 10-11363

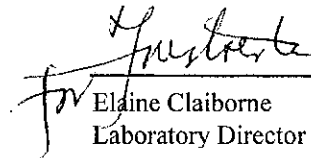
Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.315	mg/L	EFA 7/14/10	1236

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director

Date: 16-Jul-10

RECEIVED JUL 21 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
 ATTN: Cody Hoehna
 ADDRESS: 218 N. Main Street
 Culpeper, VA 22701
 PHONE: (800) 541-2116
 FAX: (540) 825-4961

SAMPLE COLLECTED BY: CLIENT
 GRAB COLLECTION:

Date: 7/7/10 Time: 1130

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

Special Notes:

RE: RAPPAHANNOCK WATER AND
 SEWER AUTHORITY - WER STUDY

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 1130

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SFW
 SAMPLE NO: 10-11173

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
TOC	*5310B	0.5	1.0	mg/L	ARC	7/13/10	0822
Dissolved Organic Carbon	*5310B	0.5	< 0.5	mg/L	ARC	7/13/10	0822

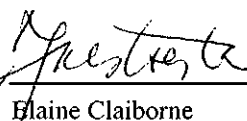
NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

RESPECTFULLY SUBMITTED

for 
 Elaine Claiborne
 Laboratory Director
 Date: 16-Jul-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

RE: RAPPAHANNOCK WATER AND
SEWER AUTHORITY - WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 7/7/10 Time: 1130

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 7/8/10 Time: 1130

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SITE
SAMPLE NO: 10-11174

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
TOC	*5310B	0.5	6.2	mg/L	ARC	7/13/10	0822
Dissolved Organic Carbon	*5310B	0.5	3.5	mg/L	ARC	7/13/10	0822

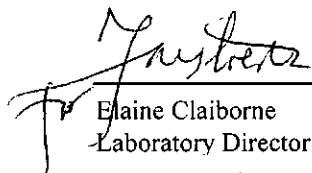
NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

RESPECTFULLY SUBMITTED


Elaine Claiborne
Laboratory Director
Date: 16-Jul-10



ANALYSES REQUESTED

[illegible][illegible][illegible]

*WW= Wastewater, GW = Groundwater, DW - Drinking Water, HW - Hazardous Waste, OTHERS

Preservatives:

1 = $<6^{\circ}\text{C}$ 6 = $\text{Na}_2\text{S}_2\text{O}_3 + \text{HCl}$ 10 = Ascorbic Acid + HCl
 2 = HNO_3 7 = $\text{NaOH} + \text{ZnOAc}$ 11 = HCl
 3 = H_2SO_4 8 = $\text{H}_2\text{SO}_4 + \text{FAS}$ 12 = Zinc Acetate + NaOH
 4 = NaOH 9 = NH_4Cl 13 = $\text{Na}_2\text{SO}_3 + \text{HCl}$
 5 = $\text{Na}_2\text{S}_2\text{O}_3$ 14 = $\text{Na}_2\text{SO}_3 + \text{H}_2\text{SO}_4$

VOA Chlorine Check: POS___NEG___ By:_____
Dechlorinated: Yes

CN Interference Check:	Positive	Negative
Sulfide:	_____	_____
Oxidizing Agent:	_____	_____

* TOC received in incorrectly preserved container, client (Cody Hoehna) notified that DOC sample was used to pour off for TOC & preserved w/ HCl upon arrival. Arrival Temp: 5.8 °C

JAMES R. REED and ASSOCIATES (757) 873-4703; FAX (757) 873-1498

770 Pilot House Drive, Newport News, VA 23606

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SITE
SAMPLE NO: 10-13159

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Dissolved Organic Carbon	*5310B	0.5	6.7	mg/L	ARC 8/10/10	1201

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

NOTE: TOC analysis was performed on H2SO4 preserved sample.

Result is qualitative only and will be reanalyzed on an aliquot
with HCL preservation.

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

RECEIVED AUG 23 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SFW
SAMPLE NO: 10-13160

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Dissolved Organic Carbon	*5310B	0.5	0.8	mg/L	ARC 8/10/10	1201

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

NOTE: TOC analysis was performed on H2SO4 preserved sample.

Result is qualitative only and will be reanalyzed on an aliquot
with HCL preservation.

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: LC
SAMPLE NO: 10-13161

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	< 0.002	mg/L	EFA 8/18/10	1523

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED



Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L3
SAMPLE NO: 10-13162

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.013	mg/L	EFA 8/18/10	1525

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED



Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L4
SAMPLE NO: 10-13163

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
Total Copper	200.7	0.002	0.018	mg/L	EFA	8/18/10	1533

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L5
SAMPLE NO: 10-13164

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.025	mg/L	EFA 8/18/10	1535

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L6
SAMPLE NO: 10-13165

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
Total Copper	200.7	0.002	0.034	mg/L	EFA	8/18/10	1536

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: L7
SAMPLE NO: 10-13166

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
Total Copper	200.7	0.002	0.050	mg/L	EFA	8/18/10	1538

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S4 + SC
SAMPLE NO: 10-13167

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	*	mg/L	EFA 8/18/10	1540

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

* #1 S4- 0.220 mg/L

* #2 SC- 0.017 mg/L

RESPECTFULLY SUBMITTED



Elaine Claiborne
Laboratory Director

Date: 23-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT
GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S5 + S6
SAMPLE NO: 10-13168

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	*	mg/L	EFA 8/18/10	1544

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

* #1 S5- 0.302 mg/L

* #2 S6- 0.632 mg/L

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 23-Aug-10



CHAIN OF CUSTODY

Company Name: Environmental System Services
Company Contact: Cedy Hoehna Telephone: 540-925-1616
Results To: " Fax: 540-925-4961
Address: 218 N Main St.
Culpeper, VA 22701
Project ID: Sperryville WER Study

		ANALYSES REQUESTED													
Bottle I.D.	Preserv.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	B	A													
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14

JRA ID #	Sample Type*	Sample Location	Composite				Grab		Total # of cont.	DOC	DOC	DOC	DOC	DOC	DOC	DOC	DOC	DOC	DOC
			Start Date	Start Time	End Date	End Time	Date	Time											
13159	WW	SITE					8/4/10	1400	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13160		SPW					"	"	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13161		LC					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13162		L3					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13163		L4					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13164		L5					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13165		L6					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13166		L7					"	"	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13167		S4 + SC					"	"	1 + 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
13168		S5 + S6					"	"	1 + 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

*WW= Wastewater, GW = Groundwater, DW - Drinking Water, HW - Hazardous Waste, OTHERS

Sampled By: PD Date/Time: 8/4/10 1700
Relinquished By: PD Date/Time: 8/5/10 1121
Received By: UPS Date/Time: 8/9/10 1100
Relinquished By: UPS Date/Time: 8/10/10 @ 0960
Received By: UPS Date/Time: 8/10/10 @ 0950

Preservatives:

1 = <6°C 6 = Na₂S₂O₃ + HCl 10 = Ascorbic Acid + HCl
2 = HNO₃ 7 = NaOH + ZnOAc 11 = HCl
3 = H₂SO₄ 8 = H₂SO₄ + FAS 12 = Zinc Acetate + NaOH
4 = NaOH 9 = NH₄Cl 13 = Na₂SO₃ + HCl
5 = Na₂S₂O₃ 14 = Na₂SO₃ + H₂SO₄

____ for Compliance
____ Not for Compliance

VOA Chlorine Check: POS ____ NEG ____ By: ____
Dechlorinated: ____ Yes

CN Interference Check: Positive ____ Negative ____
Sulfide: ____
Oxidizing Agent: ____

*DOC sample received improperly preserved - analysis could not be performed.
Informed client - they will resend TOC/DOC. RLB

Arrival Temp: 3.2 °C

JAMES R. REED and ASSOCIATES (757) 873-4703; FAX (757) 873-1498
770 Pilot House Drive, Newport News, VA 23606

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc

ATTN: Cody Hoehna

ADDRESS: 218 N. Main Street
Culpeper, VA 22701

PHONE: (800) 541-2116

FAX: (540) 825-4961

Special Notes:

RE: SPERRYVILLE WEB STUDY #2

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/19/10 Time: 1100

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/20/10 Time: 0940

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)

SAMPLE ID: SFW

SAMPLE NO: 10-13777

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
TOC	*5310B	0.5	1.6	mg/L	ARC	8/24/10	0756
Dissolved Organic Carbon	*5310B	0.5	0.8	mg/L	ARC	8/24/10	0756

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R. Reed & Associates.

*SM 20 Ed.

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director

Date: 26-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

RE: SPERRYVILLE WER STUDY #2

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: Time:

COMPOSITE COLLECTION:

Start Date: 08/02/10 Time: 0710

End Date: 08/02/10 Time: 1110

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/20/10 Time: 0940

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)

SAMPLE ID: EFFLUENT

SAMPLE NO: 10-13778

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
TOC	*5310B	0.5	6.2	mg/L	ARC 8/24/10	0756
Dissolved Organic Carbon	*5310B	0.5	4.3	mg/L	ARC 8/24/10	0756

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director

Date: 26-Aug-10

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
REVISED REPORT

(Parameter)

RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SITE
SAMPLE NO: 10-13159

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
TOC	*5310B	0.5	6.7	mg/L	ARC 8/10/10	1201

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

NOTE: TOC analysis was performed on H2SO4 preserved sample.

Result is qualitative only and will be reanalyzed on an aliquot
with HCL preservation.

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director

Date: 06-Oct-10

RECEIVED OCT 12 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Services
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:

REVISED REPORT

RE: SPERRYVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 8/10/10 Time: 0950

NUMBER OF CONTAINERS: 2

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: SFW
SAMPLE NO: 10-13160

Parameter	Method Number	JRA QL	Result	Unit	Analyst	Date	Time
TOC	*5310B	0.5	0.8	mg/L	ARC	8/10/10	1201

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.

Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.

*SM 20 Ed.

NOTE: TOC analysis was performed on H2SO4 preserved sample.

Result is qualitative only and will be reanalyzed on an aliquot
with HCL preservation.

RESPECTFULLY SUBMITTED

Elaine Claiborne

Elaine Claiborne
Laboratory Director

Date: 06-Oct-10

RECEIVED OCT 12 2010

REPORT OF ANALYSIS

CLIENT: Environmental Systems Svc
ATTN: Cody Hoehna
ADDRESS: 218 N. Main Street
Culpeper, VA 22701
PHONE: (800) 541-2116
FAX: (540) 825-4961

Special Notes:
RE: SPRINGVILLE WER STUDY

SAMPLE COLLECTED BY: CLIENT

GRAB COLLECTION:

Date: 8/4/10 Time: 1400

COMPOSITE COLLECTION:

Start Date: Time:

End Date: Time:

PICK UP BY: UPS

SAMPLE RECEIPT:

Date: 11/2/10 Time: 0940

NUMBER OF CONTAINERS: 1

SAMPLE CONDITION: ☒ Good ☐ Other (See C-O-C)



SAMPLE ID: S7
SAMPLE NO: 10-17966

Parameter	Method Number	JRA QL	Result	Unit	Analyst Date	Time
Total Copper	200.7	0.002	0.597	mg/L	EFA 11/5/10	1049

NOTES:

JRA Quantification Level is the concentration of the lowest calibration standard above zero with a reliable signal.
Reproduction of this report is not permitted, except in full, without written approval from James R Reed & Associates.
The results on this report relate only to the sample(s) provided for analysis.

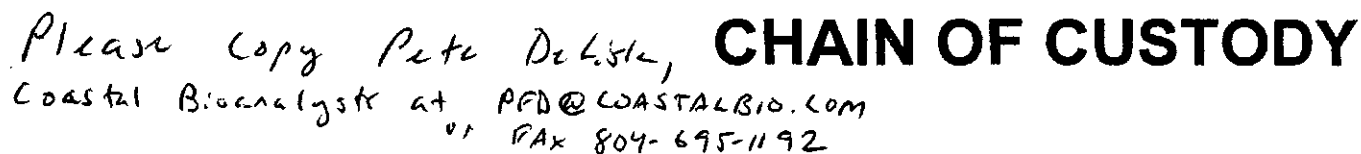
cc: Pete Delisle @ Coastal Bioanalyst

@ Fax 804-695-1192

RESPECTFULLY SUBMITTED

Elaine Claiborne
Laboratory Director
Date: 05-Nov-10

RECEIVED NOV 5 2010

**ANALYSES REQUESTED**

JAMES R. REED & ASSOCIATES (757) 873-4703 • FAX (757) 873-1498
770 Pilot House Drive, Newport News, VA 23606

* additional 2 mLs HNO_3
added to 10.17966 upon
arrival **JAM**

6



Environmental Systems Service, Ltd.

ENVIRONMENTAL SYSTEMS SERVICE, LTD.

Page: 1

Work Order #: 10124
Contract #: 06/4
Customer #: 4693
Customer PO #: SPERRYVILLE STP

RAPPAHANNOCK COUNTY WSA
ATTN: TROY JENKINS
P. O. BOX 253
SPERRYVILLE, VA 22740

Job Location: WER STUDY
Collected by: ANDRIA SWANN
Date Received: 07/06/2010

ANALYSIS REPORT

TSS LAB CONTROL STANDARD WAS ABOVE QC ACCEPTANCE LIMITS.

TAG #: SAMPLE POINT:
37143 OUTFALL 001

SAMPLE DATE:
07/05/2010

Description	Result	Unit	Rpt. Limit	Method	Anlys Date	Time	Ini
Biochemical Oxygen Demand	2	mg/l	2	SM 5210	07/06/10	15:30	MS
Total Suspended Solids	1.34	mg/l	1.00	SM 2540D	07/08/10	12:46	BW
Total Kjeldahl Nitrogen	2.18	mg/l	0.50	SM 4500NH3C	07/12/10	14:00	TA
Total Phosphorus	4.82	mg/l	0.05	SM 4500PBE	07/15/10	15:10	JI
Nitrite + Nitrate	31.7	mg/l	0.0500	SM 4500NO3F	07/12/10	13:25	DO
Total Organic Carbon	<1.00	mg/l	1.00	SM 5310C	07/09/10	16:38	DO
Dissolved Organic Carbon	<1	mg/l	1	SM 5310 C	07/09/10	16:38	DO
Total Hardness	133	mg/l	2	SM 2340C	07/08/10	12:00	PH
Alkalinity, Total	107	mg/l	2	SM 2320B	07/12/10	14:00	JI
Orthophosphate, as P	4.59	mg/l	0.05	SM 4500PE	07/06/10	17:05	JI
Copper, Dissolved	0.015	mg/l	0.005	EPA 200.8	07/12/10		HG
Copper, Total Recoverable	0.017	mg/l	0.005	EPA 200.8	07/12/10		HG
Ammonia, as N	0.61	mg/l	0.10	SM 4500NH3D	08/03/10	14:10	BW

Reviewed by:


ESS LAB SERVICES

Report Date: August 06, 2010
VA LAB ID# 00115

SAMPLE CHAIN OF CUSTODY RECORD

Company ESS
 Contact Cody Heehna
 Address _____
 Address _____
 Phone _____

ENVIRONMENTAL SYSTEMS SERVICE, LTD.



218 North Main St.
 Post Office Box 520
 Culpeper, VA 22701
 800-541-2116

540-825-6660 Fax: 540-825-4961

500 Stone St.
 Post Office Box 736
 Bedford, VA 24523
 540-586-5413
 Fax 540-586-5530

Project Name/Site Rappahannock WSA - WER STUDY P.O.# _____

Sampled By: Andria Swan Andria Swan
 (Print Name) (Signature)

ESS SAMPLE ID.	COLLECTION		SAMPLE LOCATION	CONTAINERS		GRAB	COMP	SAMPLE MATRIX	PRESERVATIVE	ANALYSES										COMMENTS
	DATE	TIME		SIZE	G/P #					BOD, TSS	TKN, TP04	NO ₂ /NO ₃	TOC	DOC	Hardness	ALK #DP04	*Diss Cu	Total Cu	NH ₃ (AS)	
31143	7/5/10	0635 to 1035	Outfall 001	1L	P 2		X	WW	none	X										* Filtered
				250	P 2				H ₂ SO ₄		X	X	X							on the
				1L	G 1				H ₂ SO ₄					X						field
				250	P 1				HNO ₃						X					
				250	P 2				none							X				
				250	P 1				HNO ₃								X			
				250	P 1		X	WW	HNO ₃									X		
																				Preservative
																				pH Check:
																				✓

Relinquished by: <u>Andria Swan</u>	Date: <u>7/5/10</u>	Time: <u>1133</u>	Received by:	Relinquished by:	Date:	Time:	Received by:
Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received for Laboratory by:
					<u>7-6-10</u>	<u>0900</u>	<u>A Woodward</u>

Method of Delivery:	On Ice? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	TAT:	W.O.# <u>10124</u>	Amt Paid \$ _____
<input type="checkbox"/> UPS <input type="checkbox"/> Fed Ex <input checked="" type="checkbox"/> Hand Delivery	Received @ <u>3.8</u> °C	Normal _____ Rush _____	W.O.# _____	Check # _____
<input type="checkbox"/> UPS Overnight <input type="checkbox"/> Post Office	<input type="checkbox"/> Under 2 hours	Need Results by _____ Extra charges will apply for Rush TAT.		

* Samples were left in walk-in refrigerator due to holiday *

SAMPLE CHAIN OF CUSTODY RECORD

ENVIRONMENTAL SYSTEMS SERVICE, LTD.

Company ESS
 Contact Cody Hoenna
 Address _____
 Address _____
 Phone _____

218 North Main St. Post Office Box 520 Culpeper, VA 22701 800-541-2116 540-825-6660	500 Stone St. Post Office Box 736 Bedford, VA 24523 540-586-5413 Fax 540-586-5530	8321 Leishear Road Laurel, MD 20723 301-617-9582 Fax 301-617-3426	3917 Westpoint Blvd. Suite E Winston-Salem, NC 27103 910-659-3378 Fax 910-659-3379
---	---	--	--

Project Name/Site Rappahannock WSA - WER STUDY P.O.# _____
 Sampled By: Andria Swann [Signature]
 (Print Name) (Signature)

ESS SAMPLE ID.	COLLECTION DATE	TIME	SAMPLE LOCATION	CONTAINERS SIZE	G/P #	GRAB	COMP	SAMPLE MATRIX	PRESERVATIVE	Hach	ALK	TK	TOC	DOC	BOB	GR	TR	NO ₃	NO ₂	COMMENTS
	7/5/10	0635-1035	Cut Fall 001	1L	P2	1	X	ww	none	X					X					
				1L	G1		X	ww	H ₂ SO ₄					X						*Filtered
				250	P2		X	ww	HNO ₃			X	X							on the
				250	P1		X	ww	HNO ₃	X										field.
				250	P3		X	ww	H ₂ SO ₄									X	X	
				250	P1		X	ww	none							X				
																				Preservative
																				pH Check:

Relinquished by: <u>[Signature]</u>	Date: <u>7/5/10</u>	Time: <u>1133</u>	Received by: _____	Relinquished by: _____	Date: _____	Time: _____	Received by: _____
Relinquished by: _____	Date: _____	Time: _____	Received by: _____	Relinquished by: _____	Date: _____	Time: _____	Received for Laboratory by: _____

Method of Delivery <input type="checkbox"/> UPS <input type="checkbox"/> UPS Overnight <input type="checkbox"/> Fed Ex <input type="checkbox"/> Post Office <input checked="" type="checkbox"/> Hand Delivery	Remarks: Received @ _____ C <input type="checkbox"/> Under 2 hours	TAT Normal _____ Rush _____ Need Results by _____ Extra charges will apply for Rush TAT.	W.O.# _____ W.O.# _____	Amt Paid \$ _____ Check # _____
--	--	---	----------------------------	------------------------------------



Log-In / Sample Receipt Form

Customer Name: Rapp Co WSA Date Received: 7/6/10
Sample Custodian: GD

Tag #	Bottle #	Parameter(s)	Container size	Temp. °C	On Ice?	pH (if preserved)	Sample condition	Sample Comments
37143	1	BOD	1L	3.8	yes	none	good	
	2	TSS	1L			none		
	3	TKN, TP04	250ml			<2		
	4	NO ₂ /NO ₃	250ml			<2		
	5	TOC	250ml			<2		
	6	DOC	1L					
	7	Hardness	250ml					
	8	ALK, OP04	250ml			none		
	9	diss Cu	250ml					
	10	total Cu	250ml					
	11	NH ₃ (3)	250ml					added - taken from TKN bottle

General Comments:

SAMPLE CHAIN OF CUSTODY RECORD

Company ESS
 Contact Cody Heerna
 Address _____
 Address _____
 Phone _____



www.ess-services.com

ENVIRONMENTAL SYSTEMS SERVICE, LTD.

218 North Main St.
 Post Office Box 520
 Culpeper, VA 22701
 800-541-2116

540-825-6660 Fax: 540-825-4961

500 Stone St.
 Post Office Box 736
 Bedford, VA 24523
 540-586-5413
 Fax 540-586-5530

Project Name/Site Rappahannock WSA -
WER STUDY P.O.# _____

Sampled By: Andria Swann Andria Swann
 (Print Name) (Signature)

ANALYSES

ESS SAMPLE ID.	COLLECTION DATE	TIME	SAMPLE LOCATION	CONTAINERS SIZE G/P #	GRAB COMP	SAMPLE MATRIX	PRESERVATIVE	BOD, TSS	TKN, TP04	NO ₂ /NO ₃	TOC	DOC	Hardness	ALK, DP04	*Diss Cu	Total Cu	NH ₃	COMMENTS
37143	7/5/10	0635 to 1035	Outfall 001	1L P 2	X	WW	none	X										* Filtered
				250 P 2			H ₂ SO ₄		X	X	X							on the
				1L G 1			H ₂ SO ₄					X						field.
				250 P 1			HNO ₃					X						
				250 P 2			none						X					
				250 P 1			HNO ₃								X			
				250 P 1	X	WW	HNO ₃									X		
																		Preservative
																		pH Check:
																		12

Relinquished by: <u>Andria Swann</u>	Date: <u>7/5/10</u>	Time: <u>1133</u>	Received by:	Relinquished by:	Date:	Time:	Received by:
Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received for Laboratory by:

Method of Delivery:	On Ice? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N	TAT:	W.O.# <u>10124</u>	Amt Paid \$ _____
<input type="checkbox"/> UPS <input type="checkbox"/> UPS Overnight <input checked="" type="checkbox"/> Fed Ex <input type="checkbox"/> Post Office <input checked="" type="checkbox"/> Hand Delivery	Received @ <u>3.8</u> °C	Normal _____ Rush _____ Need Results by _____ Extra charges will apply for Rush TAT.	W.O.# _____	Check # _____
	<input type="checkbox"/> Under 2 hours			

* Samples were left in walk-in refrigerator due to holiday *

Revised 10/20/09



Biochemical Oxygen Demand (BOD5)

Standard Methods 5210, 19th ed.

☐

CBOD

Was nitrification inhibitor added to the sample? Y N

Sample Site:

Rapp Co WSA

Tag #:

37143-1

Sample Point:

Outfall 001

Date Rec'd:

7/6/10

Sample Date:

7/5/10

Time:

1035

Sample Temp:

20.6

pH:

7.69

Cl₂:

40.03

mg/l

Dil H₂O Temp:

20.5

ml Seed:

4

drops:

/10 ml

Analyst, Set Up:

MS

Date in:

7-6-10

Time in:

1530

Analyst, Final:

JF

Date out:

7-11-10

Time out:

1302

Seed Correction Value (SCV):

0.9

(0.6-1.0)

BLANK:

0.4/0.4

(0.0-0.4)

GGA:

-

(170-230)

7/9/10

(Date last done)

Sample %

10 %	33 %	100 %	%	%	%
3020	3000	6083			
8.3	8.4	8.7			
7.0	6.6	6.0			
1.3	1.8	2.7			
-	-	1.8			
-	-	2			
Y (N)	Y (N)	(Y) N	Y N	Y N	Y N

Average BOD of 1st dilution series:

2

mg/l

(D1-D2) - SCV

= BOD5 (mg/l)

% Dilution as decimal

RPD (if duplicate performed):

QC Flags:

☐
☐
☐
☐
☐
☐
☐
☐

Blank outside of acceptance range of 0.0 - 0.4

SCV outside of acceptance range of 0.6 - 1.0

GGA outside of acceptance range of 198 ± 30.5

Each of the dilutions used in set-up failed to meet proper criteria; results are estimated

Sample set up outside of 48 hour holding time

Sample exhibits toxicity

Air bubbles present following incubation

Other

Revised: 6/25/10

Reviewed by:

JA 7/12/10



SOLIDS ANALYSIS SM 2540 19th ed.

7/5/10 ²⁵²
7/15/10

ESS TAG#

Sample Site:

Rapp Co WSA

Sample Date:

7/6/10

37143-2

Sample Point:

outfall 001

Sample Time:

1035



(TSS, MLSS, TS, TDS)

Vessel #

ml of sample used

X= wgt of filter

+ sample (dried)

Y= initial filter wgt

A= X-Y

Result (mg/l)

TSS			
1272			
970			
0.1245			
0.1232			
0.0013			
1.3402			

mg/l = $\frac{A \times 1000 \times 1000}{\text{ml of sample used}}$

Filtered for 10 minutes

Used all available sample

1246

Start Filtration

1247

End Filtration

Oven Temp

7/8/10

Analysis date

1335

Time in

100.0 In (°C)

Result

1.34

mg/l

Bcw

Analyst

1528

Time out

101.3 Out (°C)

(report 1st value if a duplicate was analyzed)

(TVSS, MLVSS, TVS)

Vessel #

X= (wgt from X above)

Z= wgt of filter

+ sample after ignition

B= X - Z

Result (mg/l)

mg/l = $\frac{B \times 1000 \times 1000}{\text{ml of sample used}}$

Analysis date

Time in

Oven Temp °C

Result

mg/l

Analyst

Time out

(report 1st value if a duplicate was analyzed)

(FSS, MLFSS, TFS)

Total result from above (mg/l)

Volatile result from above (mg/l)

Total - Volatile = Fixed (mg/l)

Result

mg/l

Reviewed by: AW 7-13-10

(report 1st value if a duplicate was analyzed)

* LCS was above QC acceptance limit

COMMENTS:

~~Sample labeled 7/5/10 as sample date~~

Revised 6/29/10

AW
7-15-10



SOLIDS ANALYSIS SM 2540 19th ed.

ESS TAG#

Sample Site:

Rapp Co WSA

Sample Date:

7/6/10

37143-2

Sample Point:

outfall 001

Sample Time:

1035

(TSS, MLSS, TS, TDS)

Vessel #

ml of sample used

X= wgt of filter

+ sample (dried)

Y= initial filter wgt

A= X-Y

Result (mg/l)

TSS			
1272			
976			
0.1245			
0.1232			
0.0013			
1.3462			

mg/l = $\frac{A \times 1000 \times 1000}{\text{ml of sample used}}$

Filtered for 10 minutes

Used all available sample

1246

Start Filtration

1247

End Filtration

Oven Temp

7/8/10

Analysis date

1335

Time in

100.0 In (°C)

Result

1.34

mg/l

Bcw

Analyst

1528

Time out

100.3 Out (°C)

(report 1st value if a duplicate was analyzed)

(TVSS, MLVSS, TVS)

Vessel #

X= (wgt from X above)

Z= wgt of filter

+ sample after ignition

B= X -Z

Result (mg/l)

mg/l = $\frac{B \times 1000 \times 1000}{\text{ml of sample used}}$

Analysis date

Time in

Oven Temp °C

Result

mg/l

Analyst

Time out

(report 1st value if a duplicate was analyzed)

(FSS, MLFSS, TFS)

Total result from above (mg/l)

Volatile result from above (mg/l)

Total - Volatile = Fixed (mg/l)

Result

mg/l

Reviewed by: AW 7-13-10

(report 1st value if a duplicate was analyzed)

* LCS was above QC acceptance limit

COMMENTS:

Bottle LABELED 7/5/10 AS SAMPLE DATE

Revised 6/29/10



NO MSA
W/ 10134

Revd 7/13
Analytics Corporation
10329 Stony Run Lane
Ashland, VA 23005
Phone: (804)365-3000
Fax: (804)365-3002

ANALYTICAL RESULTS

Workorder: 1002470 37259

Lab ID: 1002470006

Date Received: 7/7/2010 08:00

Matrix: Aqueous Liquid

Sample ID: 37143-4 OUTFALL 001

Date Collected: 7/5/2010 10:35

Samp Type: COMP

Parameters	Results	Units	Report Limit	DF Prepared	By	Analyzed	By	Qual
------------	---------	-------	--------------	-------------	----	----------	----	------

Analysis Desc: SM 5310 C		Analytical Method: SM 5310 C						
TOC	<1 mg/L		1	1		7/9/2010 16:38	DOI	

Analysis Desc: SM 4500NO3 F		Analytical Method: SM 4500NO3 F						
Nitrite-Nitrate	31.7 mg/L		0.0500	1		7/12/2010 13:25	DOI	

Report ID: 1002470 - 709358

Page 8 of 8

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Analytics Corporation.



Analytics Corporation
10329 Stony Run Lane
Ashland, VA 23005
Phone: (804)365-3000
Fax: (804)365-3002

ANALYTICAL RESULTS

Workorder: 1002472 37143

RCWSA - WER Study

Lab ID: 1002472001

Date Received: 7/7/2010 08:00

Matrix: Aqueous Liquid

Sample ID: 37143 OUTFALL 001

Date Collected: 7/5/2010 10:35

Samp Type: COMP

Parameters	Results	Units	Report Limit	DF	Prepared	By	Analyzed	By	Qual
------------	---------	-------	--------------	----	----------	----	----------	----	------

Analysis Desc: SM 5310 C

Analytical Method: SM 5310 C

DOC

<1 mg/L

1

1

7/9/2010 16:38

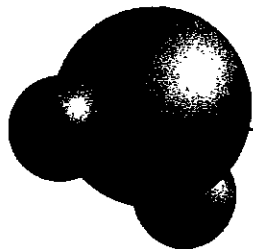
DOI

Report ID: 1002472 - 709039

Page 3 of 3

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Analytics Corporation.



chemical solutions ltd.

trace elemental analysis

AC 7/15/10

ANALYTICAL REPORT

July 13, 2010

Ms. Angie Woodward
Environmental Systems Services, Ltd.
218 N. Main Street, P.O. Box 520
Culpeper, VA 22701

Page 1 of 1
Sample No. 10G0454-5

Client : ESSL
Client # : E664
Description : See Below
Sample Type : Water
Collector : Client

Customer PO : 12215
Date Sampled :
Date Received : 07/08/10
Date Completed : 07/12/10
Discard Date : 07/27/10

10G0454*

ESS# 37143-9 D

Parameter	Result	Units	PQL	Date	Method	Analyst
Total Copper	0.015	mg/L	0.005	07/12/10	200.8	HG

10G0455*

ESS# 37143-10 - Total

Parameter	Result	Units	PQL	Date	Method	Analyst
Total Copper	0.017	mg/L	0.005	07/12/10	200.8	HG

*This sample was digested.

Respectfully Submitted,
Chemical Solutions, Ltd.

Ian Milnes
President

CONFIDENTIAL REPORT. This report is confidential and is for the sole use of the addressee.
This report can only be reproduced in full.
Chemical Solutions Ltd. is a NELAP accredited laboratory. The EPA lab code is PA01275.

CLIENT: Rapp Co WSASAMPLE POINT: Outfall 001SAMPLE DATE: 7/5/10

Tag # Parameter	Bottle #	Dilution Factor	Abs/Mls Titrant/ Raw Value	Factor	Titrant (N)	Blank (mls)	Concent. (mg/l)	Temp (°C)	Analysis Date	Analysis Time	Analyst Initials
Chloride (Cl)											
Fluoride (F)											
Alkalinity, Total	8	5x	1.11	20.3		0.06	107		07-12-10	1400	JH
Alkalinity, Bicarbonate											
Alkalinity, Carbonate											
Hardness, Total	7	2x	3.00	22.90		0.10	133		7-8-10	1200	PH
Ammonia (NH ₃ as N)	3	1x	0.6131				0.61	19.3	8/3/10	1410	BCW
Nitrite (NO ₂)											
Nitrate (NO ₃)											
TKN	3	1x	0.45	5.00		0.06	2.18		7/12/10	1400	TR
T. Phosphorus (TPO ₄)	3	10x	0.300				4.82		07-15-10	1510	JH
O. Phosphate (OPO ₄)	9	10x	0.298				4.59		07-06-10	1705	JH
Hydrogen Sulfide (HS)											
Sulfate (SO ₄)											
COD											
Color (Apparent)							CU				
Odor							TON				



Comments:

Reviewed by: AW Date: 8-5-10



Environmental Systems Service, Ltd.

ENVIRONMENTAL SYSTEMS SERVICE, LTD.

Page: 1

Work Order #: 10778
Contract #: 06/4
Customer #: 4693
Customer PO #: SPERRYVILLE STP

RAPPAHANNOCK COUNTY WSA
ATTN: TROY JENKINS
P. O. BOX 253
SPERRYVILLE, VA 22740

Job Location: RAPPAHANNOCK WER STUDY
Collected by: ANDRIA SWANN
Date Received: 08/02/2010

ANALYSIS REPORT

TAG #: 38062
SAMPLE POINT: OUTFALL 001

SAMPLE DATE:
08/02/2010


Description	Result	Unit	Rpt. Limit	Method	Anlys Date	Time	Ini
Biochemical Oxygen Demand	<2	mg/l	2	SM 5210	08/03/10	15:15	TA
Total Suspended Solids	3.40	mg/l	1.00	SM 2540D	08/05/10	12:54	BW
Total Kjeldahl Nitrogen	3.01	mg/l	0.50	SM 4500NH3C	08/11/10	08:00	TA
Total Phosphorus	5.08	mg/l	0.05	SM 4500PBE	08/23/10	15:10	JI
Ammonia, as N	0.17	mg/l	0.10	SM 4500NH3D	08/16/10	14:30	BW
Nitrite + Nitrate	38.9	mg/l	0.0500	SM 4500NO3F	08/10/10	15:15	DOI
Total Organic Carbon	<1.00	mg/l	1.00	SM 5310C	08/04/10	15:27	DOI
Dissolved Organic Carbon	<1	mg/l	1	SM 5310 C	08/04/10	15:27	DOI
Total Hardness	207	mg/l	2	SM 2340C	08/04/10	14:30	JI
Alkalinity, Total	100	mg/l	2	SM 2320B	08/06/10	10:25	MS
Orthophosphate, as P	4.99	mg/l	0.05	SM 4500PE	08/03/10	14:00	JI
Copper, Total Recoverable	0.019	mg/l	0.005	EPA 200.8	08/11/10		HG
Escherichia coli (100 ml)	<1	MPN	1	COLILERT	08/02/10	15:35	TA

TAG #: 38063
SAMPLE POINT: OUTFALL 001

SAMPLE DATE:
08/02/2010

Description	Result	Unit	Rpt. Limit	Method	Anlys Date	Time	Ini
Copper, Dissolved	0.018	mg/l	0.005	EPA 200.8	08/11/10		HG

Reviewed by:


ESS LAB SERVICES

Report Date: August 31, 2010
VA LAB ID# 00115

SAMPLE CHAIN OF CUSTODY RECORD

ENVIRONMENTAL SYSTEMS SERVICE, LTD.

Company ESS
 Contact _____
 Address _____
 Address _____
 Phone _____



218 North Main St.
 Post Office Box 520
 Culpeper, VA 22701
 800-541-2116
 540-825-6660 Fax: 540-825-4961

500 Stone St.
 Post Office Box 736
 Bedford, VA 24523
 540-586-5413
 Fax 540-586-5530

Project Name/Site Rappahannock WSA
WER Study P.O.# _____

Sampled By: Andrea Swann Andrea Swann
 (Print Name) (Signature)

ESS SAMPLE ID.	COLLECTION		SAMPLE LOCATION	CONTAINERS		GRAB	COMP	SAMPLE MATRIX	PRESERVATIVE	ANALYSES										COMMENTS
	DATE	TIME		SIZE	G/P #					BOD: TSS	TKN, TPO4, NH3	NO2/NO3, TOC	DOC	Hardness	Alkalinity, OPO4	**Diss. Cu	Total Cu	E.coli		
38062	8/2/10	1115	Outfall 001	1L	P 2		X	ww	none	X									**Filtered in	
				500 ml	P 2		X	ww	H2SO4		X	X							Field	
				1L	G 1		X	ww	H2SO4				X							
				250 ml	P 1		X	ww	HN03				X							
38063				500 ml	P 1		X	ww	none					X						
				250 ml	P 2		X	ww	HN03					X	X					
38062				125 ml	P 3		X	ww	Na Thios.								X			
																		Preservative		
																		pH Check:		
																		42		

Relinquished by: <u>Andrea Swann</u>	Date: <u>8/2/10</u>	Time: <u>1450</u>	Received by: _____	Relinquished by: _____	Date: _____	Time: _____	Received by: _____
Relinquished by: _____	Date: _____	Time: _____	Received by: _____	Relinquished by: _____	Date: <u>8-2-10</u>	Time: <u>1500</u>	Received for Laboratory by: <u>[Signature]</u>

Method of Delivery: <input type="checkbox"/> UPS <input type="checkbox"/> Fed Ex <input checked="" type="checkbox"/> Hand Delivery <input type="checkbox"/> UPS Overnight <input type="checkbox"/> Post Office	On Ice? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N Received @ <u>3.7</u> °C <input type="checkbox"/> Under 2 hours	TAT: Normal _____ Rush _____ Need Results by _____ Extra charges will apply for Rush TAT.	W.O.# <u>10778</u> W.O.# _____ Amt Paid \$ _____ Check # _____
---	--	--	---

* OPO4 + DISS Cu filtered in the field.

Revised 7/30/10



Biochemical Oxygen Demand (BOD5)

Standard Methods 5210, 19th ed.



CBOD

Was nitrification inhibitor added to the sample? Y N

Sample Site:

Rappahannock-Wer Study

Tag #:

38062

Sample Point:

outfall 001

Date Rec'd:

8-2-10

Sample Date:

8-2-10

Time:

1115

Sample Temp:

20.20

pH:

7.66

Cl2:

40.03

mg/l

Dil H2O Temp:

20.70

ml Seed:

4

drops:

/10 ml

Analyst, Set Up:

TA

Date in:

8/3/10

Time in:

1515

Analyst, Final:

BCW

Date out:

8/8/10

Time out:

1111

Seed Correction Value (SCV):

(0.79) 0.8
(0.6-1.0)

BLANK:

0.3
(0.0-0.4)

GGA:

-

8/6/10

(170-230)

(Date last done)

Sample %

10 %	33 %	100 %	%	%	%
43/15	0122	1004			
8.7	8.7	8.7			
7.5	7.4	6.6			
1.2	1.3	2.1			
0.4	0.5	1.3			
4.1	1.5	1.3			
Y N	Y N	Y N	Y N	Y N	Y N

Bottle#

(D1) Initial DO

(D2) Final DO

(must be ≥ 1.0 for calculation)

Depletion

(must be ≥ 2.0 for calculation)

Depletion - SCV

BOD5 (mg/l)

Meets 2:1 Criteria

Average BOD of 1st dilution series:

2.30
mg/l

< 2

TA 8/9/10

(D1-D2) - SCV

= BOD5 (mg/l)

% Dilution as decimal

RPD (if duplicate performed):

QC Flags:

☐
☐
☐
☐
☐
☐
☐
☐

Blank outside of acceptance range of 0.0 - 0.4

SCV outside of acceptance range of 0.6 - 1.0

GGA outside of acceptance range of 198 ± 30.5

Each of the dilutions used in set-up failed to meet proper criteria; results are estimated

Sample set up outside of 48 hour holding time

Sample exhibits toxicity

Air bubbles present following incubation

Other

**SOLIDS ANALYSIS SM 2540 19th ed.**

ESS TAG#

38062-2

Sample Site:

Sample Point:

Pappahannock-Wen
outfall 001

Sample Date:

Sample Time:

8-2-10
1115**(TSS, MLSS, TS, TDS)**

Vessel #

ml of sample used

X = wgt of filter

+ sample (dried)

Y = initial filter wgt

A = X - Y

Result (mg/l)

TSS			
5669			
1000			
0.1237			
0.1203			
0.0034			
3.46			

mg/l = $\frac{A \times 1000 \times 1000}{\text{ml of sample used}}$

Filtered for 10 minutes

Used all available sample

1254

Start Filtration

1255

End Filtration

Oven Temp

8/8/10

Analysis date

1321

Time in

101.2 In (°C)BCW

Analyst

1437

Time out

101.2 Out (°C)

Result

3.46

mg/l

(report 1st value if a duplicate was analyzed)

(TVSS, MLVSS, TVS)

Vessel #

X = (wgt from X above)

Z = wgt of filter

+ sample after ignition

B = X - Z

Result (mg/l)

mg/l = $\frac{B \times 1000 \times 1000}{\text{ml of sample used}}$

Analysis date

Time in

Oven Temp °C

Result

mg/l

Analyst

Time out

(report 1st value if a duplicate was analyzed)

(FSS, MLFSS, TFS)

Total result from above (mg/l)

Volatile result from above (mg/l)

Total - Volatile = Fixed (mg/l)

Result

mg/l

(report 1st value if a duplicate was analyzed)

Reviewed by: AW 8-9-10

COMMENTS:

Revised 6/29/10

CLIENT: Rappahannock-WEK SAMPLE POINT: outfall 001 SAMPLE DATE: 8-2-10

Tag # Parameter	Bottle #	Dilution Factor	Abs/MLs Titrant/ Raw Value	Factor	Titrant (N)	Blank (mls)	Concent. (mg/l)	Temp (°C)	Analysis Date	Analysis Time	Analyst Initials
Chloride (Cl)											
Fluoride (F)											
Alkalinity, Total	7	5x	1.09	19.8		0.08	100		8-6-10	1035	MS
Alkalinity, Bicarbonate											
Alkalinity, Carbonate											
Hardness, Total	6	2x	4.54	23.3		0.10	207		08-04-10	1430	JF
Ammonia (NH ₃ as N)	3	1x	0.1714				0.17	19.9	8/16/10	1430	BCW
Nitrite (NO ₂)											
Nitrate (NO ₃)											
TKN	3	1x	0.60	558		0.06	3.01		8/11/10	800	TA
T. Phosphorus (TPO ₄)	3	25x	0.127				5.08		8/23/10	1510	JF
O. Phosphate (OPO ₄)	7	10x	0.323				4.99		08-03-10	1400	JF
Hydrogen Sulfide (HS)											
Sulfate (SO ₄)											
COD											
Color (Apparent)							CU				
Odor							TON				



Comments:

Reviewed by: AW Date: 8-30-10



AC 8/10/10
Analytics Corporation
10329 Stony Run Lane
Ashland, VA 23005
Phone: (804)365-3000
Fax: (804)365-3002

ANALYTICAL RESULTS

Workorder: 1002898 38044

Rapp (Wen Study) u/c# 10778

Lab ID: 1002898007

Date Received: 8/4/2010 09:00

Matrix: Aqueous Liquid

Sample ID: 38062 OUTFALL 001

Date Collected: 8/2/2010 00:00

Samp Type: COMP

Parameters	Results	Units	Report Limit	DF	Prepared	By	Analyzed	By	Qual
------------	---------	-------	--------------	----	----------	----	----------	----	------

Analysis Desc: SM 5310 C

Analytical Method: SM 5310 C

TOC

<1 mg/L

1

1

8/4/2010 15:27

DOI

Analysis Desc: SM 4500NO3 F

Analytical Method: SM 4500NO3 F

Nitrite-Nitrate

38.9 mg/L

0.0500

1

8/10/2010 15:15

DOI

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Analytics Corporation.

Ne 8/12/10



Analytics Corporation
10329 Stony Run Lane
Ashland, VA 23005
Phone: (804)365-3000
Fax: (804)365-3002

ANALYTICAL RESULTS

Rapp Co Wei Study w/ #10778

Workorder: 1002897 38042

Lab ID: 1002897002

Date Received: 8/4/2010 09:00

Matrix: Aqueous Liquid

Sample ID: 38062 OUTFALL 001

Date Collected: 8/2/2010 00:00

Samp Type: COMP

Parameters	Results	Units	Report Limit	DF	Prepared	By	Analyzed	By	Qual
------------	---------	-------	--------------	----	----------	----	----------	----	------

Analysis Desc: SM 5310 C

Analytical Method: SM 5310 C

DOC

<1 mg/L

1

1

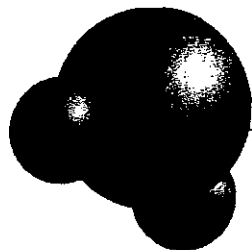
8/4/2010 15:27

DOI

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Analytics Corporation.

NC 8/16/10



chemical solutions ltd.
trace elemental analysis

ANALYTICAL REPORT

August 12, 2010

Ms. Angie Woodward
Environmental Systems Services, Ltd.
218 N. Main Street, P.O. Box 520
Culpeper, VA 22701

Page 1 of 1
Sample No. 10H0589

Client : ESSL
Client # : E664
Description : See Below
Sample Type : Water
Collector : Client

*Rapp Co
Sperryville
w/ # 10778*

Customer PO : 12246
Date Sampled :
Date Received : 08/09/10
Date Completed : 08/11/10
Discard Date : 08/26/10

10H0589* **ESS # 38062**

Parameter	Result	Units	PQL	Date	Method	Analyst
Copper	0.019	mg/L	0.005	08/11/10	200.8	HG

* This sample was digested.

Respectfully Submitted,
Chemical Solutions, Ltd.

Ian Milnes
President

CONFIDENTIAL REPORT. This report is confidential and is for the sole use of the addressee.
This report can only be reproduced in full.
Chemical Solutions Ltd. is a NELAP accredited laboratory. The EPA lab code is PA01275.

nc 8/16/10



chemical solutions ltd.
trace elemental analysis

ANALYTICAL REPORT

August 12, 2010

Ms. Angie Woodward
Environmental Systems Services, Ltd.
218 N. Main Street, P.O. Box 520
Culpeper, VA 22701

Page 1 of 1
Sample No. 10H0590

Client : ESSL
Client # : E664
Description : See Below
Sample Type : Water
Collector : Client

*Rapp Co
Sperryville
W/O # 10778*

Customer PO : 12246
Date Sampled :
Date Received : 08/09/10
Date Completed : 08/11/10
Discard Date : 08/26/10

10H0590* **ESS # 38063**

Parameter	Result	Units	PQL	Date	Method	Analyst
Copper	0.018	mg/L	0.005	08/11/10	200.8	HG

* This sample was digested.

Respectfully Submitted,
Chemical Solutions, Ltd.

Ian Milnes
President

CONFIDENTIAL REPORT. This report is confidential and is for the sole use of the addressee.
This report can only be reproduced in full.
Chemical Solutions Ltd. is a NELAP accredited laboratory. The EPA lab code is PA01275.



Time of Receipt: 1500
(sample must be set up within 2 hours of receipt)

(Check one)

☐ 18 hour

☒ 24 hour

***E. coli* by Quanti-Tray 2000**
IDEXX Colilert

Customer: Rappahannock-Wer Study Sample #: 38062

Sample Point: outfall001

Sample Date: 8-2-10 Sample Time: 1115

Date In: 8/2/10 Time In: 1535 Analyst In: TA

Date Out: 8/3/10 Time Out: 1540 Analyst Out: TA

***E. coli*:**

# Fluorescing <u>Large</u> Wells (0-49)	<u>0</u>
# Fluorescing <u>Small</u> Wells (0-48)	<u>0</u>

MPN/100 ml =

<1

(Refer to IDEXX Quanti-Tray / 2000 MPN Table)

Comments:

Reviewed by: AW Date: 8-4-10